Examination Papers for Civil Engineers before the New York Municipal Service Examining Board.

Examination of Candidates for Position of Assistant Engineer.*

ARITHMETIC.

1. A force of 29 shovellers in 7 days completed the excavation of 5,000 cubic yards of loose sand. How many men should be put to work, to excavate 4200 cubic yards in five days?

2. The monthly estimates show that contractor Jones did $9872.50 worth of work during the month. He is entitled to 80% present payment, the remainder being retained as security until completion of contract. But the company finds that it can pay only 87% of its monthly indebtedness. How much money will contractor Jones get?

3. The outside dimensions of a railroad depot are 120 feet by 65 feet. The company is so well pleased with its arrangements and shape that it orders another to be built, on exactly the same plan, in a smaller town; it is to have the same proportions but to occupy exactly half the ground space. What must be length and breadth of new depot?

ANALYSIS.

It was determined to test the efficiency of three earth-excavators, *A*, *B* and *C*, already in use. It was found that *A* required ten days, *B* nine days, *C* seven days to excavate in each case the same quantity of like material.

Soon after, it was necessary to excavate in the shortest possible time a quantity of same material equal to that previously excavated by all three machines, or three times the quantity excavated by any one as described above.

The engineer was asked to calculate how many days would be required to complete the work, all three machines being used. How many days would be required?

GEOMETRY.

AB is a line: *C* is a point thereon. It is required to draw a perpendicular to *AB* at the point *C*, without use of right-angled triangle or protractor.

A *C* *B*

2.—Inscribe an equilateral triangle in a circle.

3.—Calculate the length of one side of above equilateral triangle in terms of the radius.

MENSURATION.

Sketch No. 1.* shows an isometric view of a portion of a skew-faced wing-wall of an arched culvert. Sketch No. 2. is the plan. There is no batter except on the skew-face. The dimensions are marked. Required the exact quantity of masonry in this wing-wall.

TRIGONOMETRY.

The hypothenuse of a right-angled triangle measures 1.243 feet, another side measures .097684 feet.

Required the number of degrees, minutes and seconds in the included angle.

PHYSICS.

What is meant by a foot pound; a horse power? Describe the lever and explain its advantages.

SURVEYING.

1.—*Inaccessible Distances.* It is required to determine the distance across an impassible ravine from Station *A* on one side to a flag on the other. Following our field notes:

Station	*A*	to flag	N	76°	W	——
"	*A*	" Sta. *B*	N	10°	E	220 ft.
"	*B*	" *C*	N	2°	W	163 "
"	*C*	flag	S	85°	W	——

Stations *A*, *B*, *C* are, of course, on same side of ravine and the flag on the other.

2. *Railroad Curves.*—A curve 550 feet long is retraced on the ground from point of curvature to point of tangency, but misses latter point by 16". How shall the curve be adjusted, the conditions being that the points of curvature and tangency must remain unchanged?

3. *Adjustments.*—In the transit what is the adjustment most frequently required? How is this adjustment effected?

4. Suppose an engineer is sent to examine a valley with the view of ascertaining the practicability of gathering water there by means of an impounding dam. What investigations should he make, and what determinations by survey?

MECHANICS.

1.—A lifting draw-bridge has thirty feet span and weighs 350 lbs. per running foot. It has two lifting chains which are attached to the far end of the truss and run over wheels on upright posts thirty feet high. What is the strain upon each chain just at the moment when the truss is lifted free from the pier at the far end?

3.—A reservoir wall is to be thirty-five feet high, built of masonry to weigh 145 lbs. to the cubic foot, and to be without batter on either side. The water is thirty feet deep and weighs 62 lbs. per cubic foot. How thick must the wall be in order to just resist the overturning power of water? How thick must it be to have a safety factor of 4?

MASONRY.

1.—How would you carry an aqueduct across a swamp thirty to forty feet deep with solid substratum?

2.—Make diagram of a cross-section of such an aqueduct, showing everything from foundation up.

3.—What are the various advantages of putting a pavement in culverts? How would you prevent the stream from undermining the pavement, and, perhaps eventually, the whole structure?

4.—Describe the different classes of masonry ordinarily used.

5.—To what faults are dishonest masons liable?

TIMBER.

1.—What conditions are favorable to wet rot? What to dry rot?

2.—What means are used to preserve timber?

IRON

1.—What is steel? If you can, describe its manufacture from cast iron, from wrought iron or directly from pig iron. What are its constitution and qualities? To what uses is steel put?

2.—What is meant by red-short iron? By cold-short iron? How is iron work preserved from rusting?

STRENGTH OF MATERIALS.

1.—What is meant by these terms: Breaking Strain, Safe Strain, Limit of Elasticity, Set, Fatigue, Working Strain?

2.—What is the most economical shape for beam supported at middle only, to bear its own weight? Make diagram. What is the most economical shape of the beam, bearing its own weight, when supported at both ends on piers? Make diagram.

3.—What is meant by "line of pressures" in arches? Show why this is an important subject.

HYDRAULICS.

Describe how you would proceed to make a cross-section of a river about a third of a mile wide and from ten to thirty feet deep.

General Information Concerning the Examinations.

The following remarks refer especially to the examinations of assistant engineers.

Arithmetic.—The candidate is expected to be familiar with the whole of pure arithmetic; of applied arithmetic with Interest only.

Algebra—For the question marked ANALYSIS may be substituted an equation or two in algebra as far as quadratics. Hereafter, when algebra appears, the candidate will have the option of discussing either such question or a substitute of more directly practical nature furnished at the same time.

Geometry.—The candidate is expected to have studied at some time previous to the examination the entire subject of Euclidean Geometry. It is not, however, the intention to examine him upon the geometry of planes, of solids or of spherical surfaces; and of the remaining part only for those theorems or problems which are frequently used in general engineering practice, from a portion of the examination.

Trigonometry.—Questions do not call for the recollection or use of the formula of analytical or spherical Trigonometry, but are framed almost solely with the object of testing the candidate's skill in using logarithms whether of numbers or of circular functions.

Physics.—No questions are asked touching upon subjects of Sound, Light, Electricity or Magnetism.

Indeed, it is not recommended that intending candidates should "study up" on the subjects of geometry, trigonometry or physics. A course of cramming will hardly improve an engineer, and is useless for the kind of questions to be answered, the latter being intended to touch upon those points only, which are likely to remain fixed in the mind of the practising engineer, not by study but by use.

The remaining subjects of questions require, perhaps, no further explanation.

Books of Reference.—There is no special objection to the use of engineer's pocket books of information, by candidates engaged in the solution of problems requiring formula or tabular numbers. But in answer to questions concerning engineering operations, materials and instruments, it seems best to seek for the impressions made upon the candidate's mind by his experience, and not by his immediate study.

Until a few weeks since, when they were fixedly housed, the examiners led a nomadic life; their library and cabinet of instruments were no larger than could be conveniently carried under the arm, and, consequently books could not be provided for a dozen or more of men. To avoid the difficulty of an inadequate supply brought by the candidates themselves and which they might not care to lend, those under examination have been advised that they might, after analysing a problem, state how they would use their books to arrive at the numerical results.

Thus, to the questions given below and used in a different paper from that printed in this issue, answers were given somewhat as follows after and full credit given therefor.

1st. A plate of iron must have a top surface of 100 square feet; the length must be three times the width. Calculate the dimensions of the plate to two decimal places.

2d. A wall 30 feet high, 10 feet thick, without batter, separates two basins of water; the water is 25 feet deep on one side and 10 feet deep on the other. Determine the tendency of the water to push the wall from its position. Also determine the tendency of the water to overturn the wall; and determine the power of the wall to resist these tendencies. The wall being 100 feet long, the weight of the water 62 lbs. to the cubic foot and the weight of the wall 164 lbs. to the cubic foot.

1st. Since the rectangle is three times as long as broad and contains 100 square feet, it may be divided transversly into three equal squares containing each 33⅓ square feet. The square root of this is the width, and three times the width is the length. I do not remember the rule for finding square roots, but in practice would use tables, or, if necessary, learn the rule.

2nd. The pressure of the water on the left can be considered to act at one point, (I think one third the depth from bottom, but would assure myself.) The intensity of pressure is I think, equal to the depth multiplied by width and by half depth again and finally by weight of water in cubic foot. This amounts to $25 \times 100 \times 12\frac{1}{2} \times 62 = 1{,}937{,}500$ lbs. The tendency to overturn wall is this pressure multiplied by distance of point of application from the bottom. The weight of wall multiplied by half its width, represents the power of the wall to resist being overturned; and this is aided by the movement of the pressure of water on the other side, found in the same way. As I am not quite sure of the formula it would be useless to try to give the exact answer in figures.

Both answers show an intelligent and correct comprehension and analysis of the problems, and the examiners could not but be fully satisfied that the candidate is capable of solving them. On the other hand, men, who have stated that the contrary pressures on the lowest 10 feet of the wall counterbalance each other, and have thereupon carefully figured out the effect of the upper stratum of 15 feet of water, have been credited nothing for their utter ignorance of one of the fundamental principles of physics, that needs not mathematics, but common sense for its establishment.

The examination papers are now so arranged that all the problems, in the solution of which it is advisable to allow candidates to use their books, are placed together and form the first afternoon's work. To this the candidates are invited to bring their books, omissions to do so being remedied as much as possible by the examinations. The second afternoon's work is descriptive and the use of books is prohibited.

Scheme of Weights.—Besides the standing secured by the candidate in this part of the examination, he is credited according to his *Experience*, his *Efficiency and accuracy in work* and his *character for maintaining discipline among his subordinates*, as shown by his statements and exhibits. The relative weights attached to these several parts of the examination are by regulation fixed as follows:

Efficiency and Accuracy in Work	15
Character for Maintaining Discipline	15
Experience	20
Technical Knowledge	50

The column of figures contains the coefficients belonging each to the item found in the same line. For instance, if the marks received by a candidate should be, in this order, 80—70—60—75, his final work would be

$$\frac{80 \times 15 \times 70 \times 15 \times 60 \times 20 \times 75 \times 50}{100}$$

The questions in the examination as to technical knowledge, also, may among themselves be invested with such various weights as to the examiners deem best; but, if this be done, such values must be announced or otherwise indicated to the candidates at the beginning of the examination.

Efficiency and Accuracy in Work.—Candidates are called upon to furnish names of persons to whom the Examining Board may direct inquiries on this point for its further satisfaction in case of success being achieved in the technical examination.

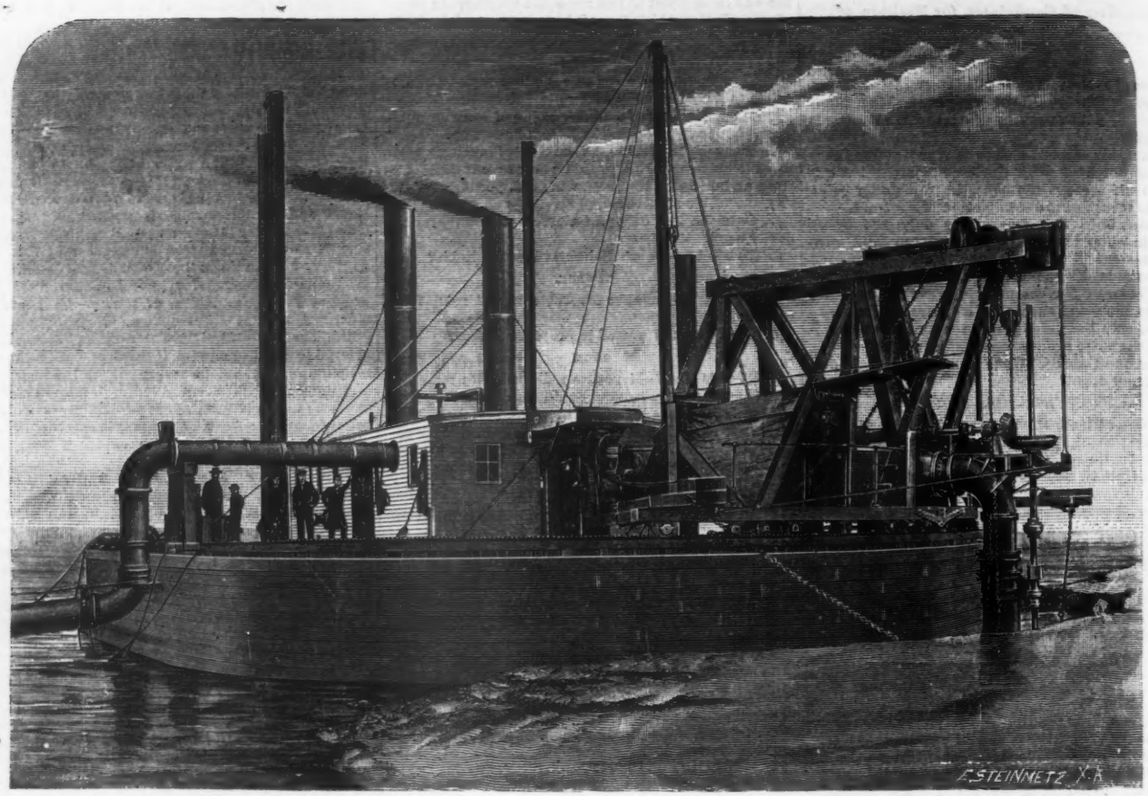
Character for Maintaining Discipline.—The candidate is called upon for references on this point also. The references may, of course, be the same as before. It would be well and save delay of the mails if all candidates would at the outset deposit with the Secretary of the Boards, among their documents relating to general experience, letters touching directly upon the points of *efficiency and accuracy* and of *character for maintaining discipline* and, afterward at the proper time refer to them as being already deposited. The examiners do not see the letters, applications or anything bearing the candidates' names or indicating their identity until the technical examination is over.

Experiences.—The mark for experience is determined by consideration of the sworn statement of the candidate made in his application and of the testimonials he chooses to deposit, viewed in connection with his work done under examination. It would, of course, not be business like to allow the statements of the candidate

* The diagrams, being very simple, are omitted.—ED ENG. NEWS.

* Candidates will please write their numbers at the top of each page of their answers, and write on only one side of the paper.

FIG. 1.---DREDGING MACHINERY, OAKLANDS, CAL.



and his acquaintances to govern independently one-half the examination; yet the greatest respect is paid to these when the candidate's own work is warranted.

In judging of experience from the candidate's answers the manner of these rather than the matter is considered. The unpractised student of engineering has learned the substance, but feels unsure of his position and imagines that each problem must be attacked in some difficult way. The practical man proceeds more directly and simply to his results, with the advantage of having seen the means of solving similar problems used—means that have been handed down through generations of engineers, corrected or approved, while his rival is inventing on the basis of the obstacles to be encountered, and the abstract principles he can call to aid. It would be useless, indeed, for the inexperienced graduate of an engineering school to undertake the examination for assistant engineers, as he would receive no credit for experience, that is, for one-half the examination.

Mistakes Made by Candidates.—It may be well to indicate here, some of the mistakes candidates make through thoughtlessness while under examination.

One gentleman of long experience as an engineer retired upon sight of an equation or two in algebra, occuring on the first page of questions presented, and about twenty days later, found a daily newspaper that was willing to base an editorial on his one-sided statement framed to convey the impression that of algebra alone the examination consisted; the algebra, in fact, made less than two and a half per cent. of the whole examination.

Another gentleman of about thirty year's experience, spent four and a half hours in answering voluminously one question in physics, thereby depriving himself of the opportunity to consider the other questions at all.

At the same examination with these two, a gentleman of brilliant intellect and remarkably fine record, but who seemed to be in a hurry, neglected to answer a large number of the questions; yet the quality of his work was so excellent that his final mark indicated about the proportion of the paper he chose to consider. This gentleman might naturally think that the examiners should take a common sense view of the case, and record him a standing commensurate with the quality of his work. The answer is this:

Competitive Versus Non-Competitive Examinations.—The candidates of large experience and evident ability, have found the non-competitive examinations reduced to a few questions, or to a mere formality, as then, there were no others to be affected by the manner of examining one. But at a competitive examination whereto come candidates of every age from under thirty to over sixty years, the method must be uniform and all the conditions the same. The questions should be so framed that of the candidates, the best, (who are presumably the men of greater experience,) should be able to show their superiority over the rest. But it would now be unjust to give the stronger an advantage over the weaker, in the race. Each answer is separately worked, and the candidates' papers are preserved side by side. If one gentleman chooses to neglect a portion of the work assigned, the examiners can only assume, in justice to the others, that he is unable to perform such work, or is careless of the results. In either case the examiners cannot take upon themselves the responsibility of filling omissions or of giving credit for answers that do not appear.

It would seem ridiculous to the examiners to announce to gentlemen professing to be practical engineers, that they should not be driven off by a single question, that they should not concentrate their whole attention upon one question, and that they should not omit a great number of questions if they desire to receive a high standing; but such things do occur, and so it is well to mention them here.

Accuracy in Figuring.—The work done during the examinations has always been remarkably accurate so far as mere figuring is concerned. One or two careless mistakes in figuring detract nothing from the mark. Several such mistakes, or one which so greatly affects the result that the error would be detected, depreciates the value of the answer.

Omissions.—Omission to answer questions has been referred to before. Candidates frequently overlook a question by mistake. When this is one of several grouped together under one number, and it seems evident that it would have been easily answered, no notice is taken of the omission. But if the question be numbered, no credit is given for no answer, for reasons already stated.

Candidates should be careful not to try to cover ignorance of the subject matter of a question beneath an avalanche of meaningless formulas and equations; and they are advised to name in the accounts of their experience the positions held by them on various works, so that the examiners need not be compelled to guess whether the offices performed were those of rodman, chief engineer or contractor.

Method of Marking.—To insure the advantage of a constant comparison of each paper with all the others, the answers to the same question made by the several candidates are examined and marked in succession before another question is considered. This entails more work upon the examiner, but enables him to avoid irregular marking.

Miscellaneous.—An examination is held for positions of a certain grade as soon after enough applicants have been enrolled as the current business of the board allows. The applicants are notified of the date by mail. The examinations begin at half past two o'clock, P. M. and last until six o'clock. The papers for assistant engineer requires sometimes two, sometimes three afternoons' work. To be placed on the eligible list a candidate must receive a mark of seventy per cent. of the maximum.

It would be well, perhaps, in this connection to furnish full particulars as to how the intending candidate should proceed from the beginning to make good his application and become entitled to an examination; but the writer does not feel sure of his ground on these points and would refer such intending candidate to the Secretary of the Municipal Service Examining Boards, or advise him to obtain and peruse a copy of the *Civil Service Regulations*.

American Dredging Machinery.*

A part of the extensive harbour improvements in progress at Oaklands, near San Francisco, consists in the excavation of a tidal basin to improve the scour, at or near the harbour entrance. The material removed by the dredging operations is deposited in adjoining marshes, and retained there by means of embankments constructed along the shore line, so that a considerable area will be reclaimed. The plan (Fig. 3) shows the extent of this part of the work. The dredging machines employed are on the same principle as those used at the Grand Amsterdam Canal Works, that is to say, they belong to the type in which the material to be raised is first reduced by suitable machinery to a condition of mud, and then pumped to the surface, and delivered by means of a pipe line. Fig. 1 illustrates the general form of the dredging machinery used at Oaklands Harbor. The submerged and mixing part of the arrangement consists of a horizontal wheel with ploughshares attached around the lower face; by means of steam

* The above description, from London *Engineering*, is condensed from a very full paper read by L. J. Le Conte, C. E., before the Am. Soc. C. E., and published in the Transactions of January, 1884.—[ED. ENGINEERING NEWS.]

FIGS. 2 & 3.—DELIVERY PIPES AND LOCATION OF WORK, OAKLANDS HARBOR, CAL.

FIG. 2.

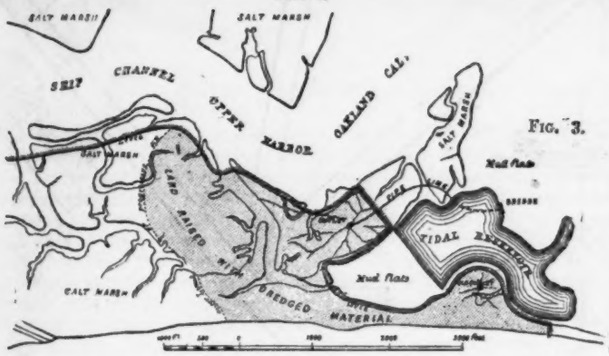

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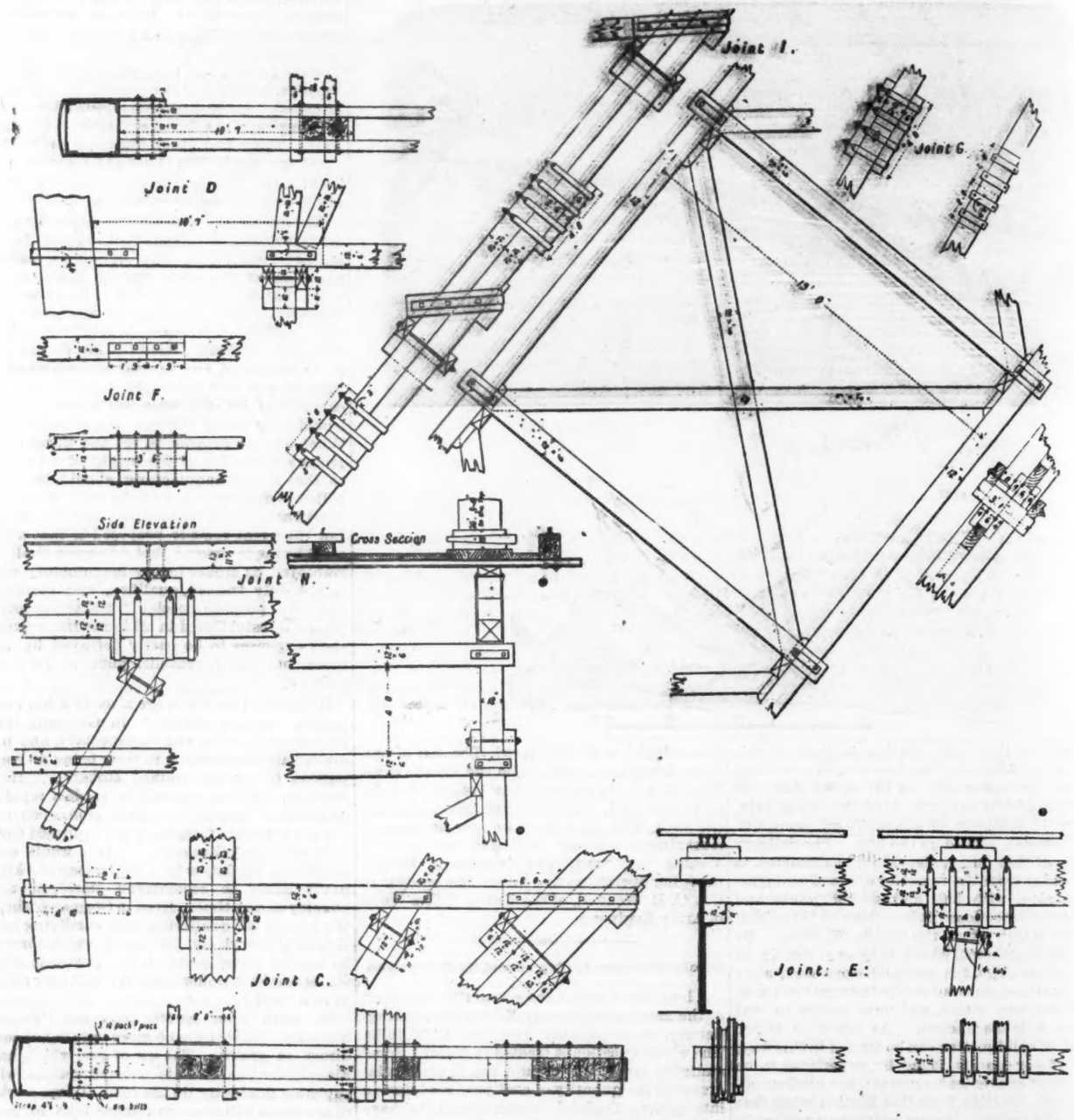
FIG. 2.—DETAILS OF STAGING, ATTOCK BRIDGE.



Staging For Bridge Over the River Indus, at Attock.

Late numbers of London *Engineering* illustrate a bridge built by F. L. O'Callaghan, Engineer in chief of the Punjaub Northern State Railway, in India, over the river Indus, at Attock. At this point the river Indus has already traversed 900 miles of its course, and the monsoon rains sometimes cause a rise of 70 ft. above the low water mark.

In designing the bridge mentioned the Engineers fixed the line for underside of girders at a point 15 ft. above the highest recorded flood. The liability of the district to earthquakes had also to be considered. At the site of the bridge the river, at low water, is 600 ft. wide, and a structure of five spans was designed to cross it; three of these spans were 250 ft. each, and two of them 300 ft. each, in the clear. For the reasons given above, and the scarcity of good building stone, the piers were rivited wrought iron structures, each pier was constructed of 8 wrought iron posts connected by horizontal and diagonal cross bracing; each column being built of four ⌊ irons, 5½ × 5½ × ⅝ in. and two plates 2 ft. 6 in. wide by ½ in. thick; two sides being solid plates, and the two other sides made up of short plates with intervals between.

As floods were liable to occur during the erection of the superstructure, the staging or false works required special consideration. For the smaller spans this portion of the work presented few difficulties, but in the 300 ft. spans across the channel the method forming the subject of our illustration was devised. In these spans no intermediate supports could be erected as they cross the main channel of the river, and the velocity of the water at its lowest, exceeds five miles an hour in the third span, sweeping the rocky surface clean. The frequency also with which rafts of timber from the upper reaches pass, often without men to guide them, also large boats with produce, add to the dangers a staging with intermediate supports would have had to encounter. Moreover it was desirable that any staging should be practically clear of cold seasons minor floods, and should allow of a rise in the river of at least 30 ft. without causing any material obstruction to the waterway.

Fig. 1 shows the general elevation of the staging for the 300 ft. span; Fig. 2 shows the details of this framing. This staging consisted of a series of long struts springing from a point near the base of each pier and spreading out in a fan to support a horizontal beam of double whole timbers on which the platform was laid for erecting the girders. The corresponding struts in the up and down stream fans (which were 19 ft. apart centre to centre, the same distance as the girders) were connected by horizontal braces, each brace being a pair of half timbers bolted together with the struts between them, and with diagonal struts in the rectangle between each pair of horizontal bracings. At equal vertical distances of 12 ft. ledgers of half timbers in pairs connected all the main struts of each fan with each other and with the main column of the pier with which they were in line, being clamped to the columns by heavy

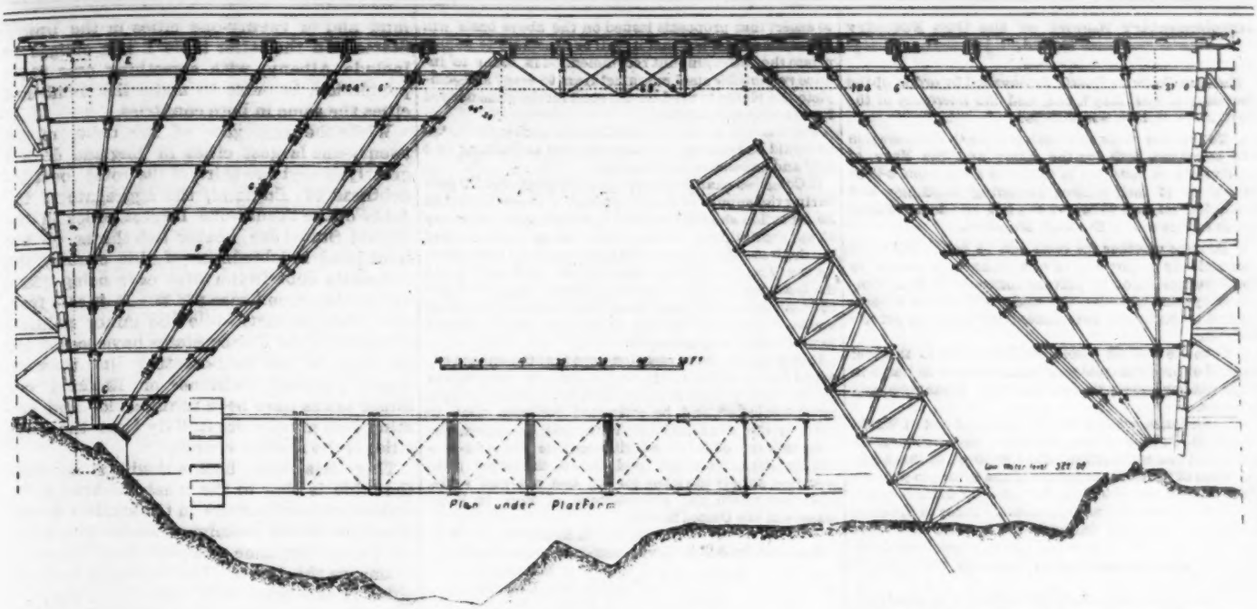


Fig. 1.---General Elevation and Plan, Staging for 300 ft. span, Attock Bridge.

wrought-iron straps. The outer main struts were built up of whole timber clamped together, commencing at the bottom with three, one of which eventually branched into a secondary strut. Similarly the vertical next the pier commenced with two whole timbers, and divided afterwards into two struts. At the level of each tier of ledgers above the fourth, counting from the bottom, sets of 1-in. chain horizontal diagonal bracings were put in. These chains were drawn tight by ordinary wagon screw couplings, four hundred of which were got out from England specially for the work.

The two outermost struts from opposite sides were connected at top by a beam of the same section being dropped in before the sill pieces were laid. This beam was 63 ft. long and of sal wood (the rest of the staging being deodar), and was trussed by three vertical struts 10 ft. deep with rods of 2 in. round iron forming a queen truss of 63 ft. span. When in place this trussed beam, together with the long struts which it connected, formed a gigantic strut and straining beam truss under the sill pieces.

During erection and until the straining beams were in place each fan was tied back to the main column of the pier with which it was in line by the ledgers, which for the time had to bear a considerable amount of tension.

The timber, readily procurable on the Indus, does not exceed an average of 22 ft. in length, and the number of joints in the work was therefore very great. The stagings were built out from the piers piece by piece, beginning with the vertical struts next the piers, which were soon carried up to their full height. To facilitate the hoisting of the timbers into place two pairs of Manilla 9 in. hawsers were stretched across each span, from the top of the 250 ft. completed girders at the shore ends and over a pyramid of sleepers placed on the top of the center pier. From these hawsers tackles were suspended at convenient points as the work progressed. When the building out of the fan portions was completed, rails were laid on the sills, and two large temporary cranes made for the purpose were moved out to the extremities. The 63 ft. trusses were then built on boats, were brought under the cranes, and were raised into place, the cast-iron angle sockets at the ends of the straining beams being dropped over the ends of the long struts, which were sprung back slightly to allow of this being done. When these were in place the sill piece was completed over the top and the platform laid on, a line of rails to the meter gauge being put upon it to bring out the girder material. These stagings proved very satisfactory; levels were taken daily at several points during the time the girders were being built to test the stagings for settlement, and, notwithstanding the great number of joints, the maximum deflection of the platforms under the full weight of over 600 tons (in addition to the weight of the staging itself), was only 1½ in. The stagings were by far the most difficult, as well as tedious, part of the work of the construction of the bridges. They were commenced on October 9, 1882, and the second one was not completed until the beginning of February, 1883. Much of this time, however, was lost by bad weather, for during high winds, which are very prevalent at Attock in the winter, it was unsafe to allow men to work in such high and exposed situations, when their hands and feet quickly become

FIG. 3.—PRIMITIVE CANTILEVER BRIDGE, INDIA.

numbed by cold, and their power of doing effective work is reduced to a minimum. As much as a week at a time was, on occasions, lost for this cause.

In this connection we also illustrate in Fig. 3, a primative cantilever bridge built by the natives across the Sutley River in a valley of the Himalayas, in India. This is taken from a sketch in a recent number of the *Pall Mall Budget*, and no special details, as to span or date of construction, are given. The description simply says that it is built by pushing out, bracket wise, timbers of deodara wood, weighted down by stone in the end cribs and then spanning the central space by planks of the same wood. It is chiefly interesting as a crude but correct application of the principles of the cantilever to bridge construction by native workmen.

ONE ton (2,000 pounds avoirdupois) of gold or silver contains 29,163 troy ounces, and therefore, the value of a ton of pure gold is $602,799.21, and a ton of silver $37,704.84.

A cubic foot of pure gold weighs 1,218.75 pounds avoirdupois; a cubic foot of pure silver weighs 655.25 pounds avoirdupois.

One million dollars gold coin weighs 3,685.8 pounds avoirdupois: $1,000,000 silver coin weighs 58,929.9 pounds avoirdupois.

Purifying Water by Aeration.

In the report of the Dec. 17, meeting of the Franklin Institute the Secretary alluded to the experiments that were being conducted under the direction of Chief Engineer Ludlow, of the Water Department of Philadelphia, with the object of purifying the water supply by a system of artificial aëration. These experiments had proved very encouraging, and promised to yield important practical results. The plan employed, which is that suggested by Dr. Albert R. Leeds, differs from others that have been employed for a similar purpose. Laboratory experiments made by Dr. Leeds indicated that the advantageous action of atmospheric air in modifying and, in part, removing the impurities of water in contact with it, was greatly increased by producing the intermingling of the two fluids under pressure. The greater the pressure, the greater is the absorption of oxygen, and consequently the greater the reduction of the impurities. The precise measure of the increase has not yet been ascertained. In order to try the experiment on a larger scale, and in such a manner as to afford some evidence of its value in practical operation, one of the Fairmount Turbine engines (No. 8) was altered so as to convert it, in part, into an air-pump, by simple mechanical artifices unnecessary to describe. The result reached by the action of the pumps thus modified, was the delivery of about 20 per cent by volume of free air into the water discharged into the main, this proportion being that which had been shown by experiments of Professor Leeds to be sufficient to surcharge the water.

By subsequent comparison of samples of water from the Fairmount pool taken into the pump, and of the water discharged into the Corinthian basin after passing through 3,600 feet of main, the results of the experiment were made apparent. The percentage of oxygen in the aerated water was 17 per cent. greater than before; that of carbonic acid was 53 per cent. greater; and that of the total dissolved gases 16 per cent. greater. The percentage of free ammonia was diminished to 1-5 of its former amount. The percentage of free oxygen represents the excess over and above what was required to effect the oxidation of the organic impurities. These results are most favorable, and point clearly to the entire feasibility of reducing the percentage of organic matters contained in water unduly contaminated with sewage, within the limits of safety.

Supplementary Report of the Gun Foundry Board.

The Gun Foundry Board, reconvened by order of the Secretary of War, May 7, 1884, and the Secretary of the Navy, April 29, 1884, was directed:

1. To prepare plans and estimates for the preparation and purchase, both for the Army and the Navy, of plants for gun factories to complete guns from 6-inch caliber to 16 inch caliber, including buildings and shrinking-pit, and to report the full and detailed estimates for the cost of the work aforesaid.

2. To state whether the same can be better and more economically performed in establishments owned by the Government, or by private contract, or by a combined system whereby the said work can be accomplished partly by the Government and partly by private contract.

3. To make specific recommendations as to the best method of procuring steel for guns, and to indicate in what manner appropriations can most advantageously be made.

In accordance with its orders, the board met in Washington, D. C., May 15, 1884, and after due consideration appointed two committees, one composed of the Army the other of the naval members of the board, to prepare plans and estimates for gun factories for their respective services, and addressed a circular letter to the steel manufacturers of the United States, in order to procure opinions, based upon practical and business considerations, as to the best method of obtaining the required supply.

The board has met with great difficulty in obtaining the desired information. No satisfactory replies having been received to its circular-letter, the board requested the assistance of Mr. James M. Swank, secretary of the American Iron and Steel Association, and by his efforts and interest a meeting was effected with leading representatives of steel manufacture, which has enabled the board to indicate the terms on which the manufacture of steel for guns of large caliber may be inaugurated in the United States.

In conclusion the board has to report.

1. The total cost of each gun factory will be about $1,-000,000.

The Army committee has restricted its estimate to the special tools for gun construction and to the erection of buildings, as indicated in the previous report of the board, omitting such details as locomotives, cars, railway tracks, pipes for the transmission of power, crane tracks, boilers engines, etc.

The estimate of the naval committee includes these auxiliaries, with the exception of locomotives and cars, which swell the estimate accordingly. The buildings proposed by the two committees differ in form and arrangement, as might be expected, for quite different sites and local conditions. A careful study of the two projects has convinced the board that when the estimates are reduced to the same standard there will be no essential difference between them.

The estimates for the tools included in the above establishments are based upon the prices of such standard articles abroad, the board not having been able to obtain satisfactory estimates for similar tools in this country.

2. The question whether the fabrication can be better and more economically performed in government establishments or by private contract or by a combined system has been carefully considered, and the board has been unable to discover any reason to modify the unanimous opinion expressed in its report of February 16, 1884, "that it is more judicious to establish gun factories;" that there should be "two gun factories under the control of the Government" and "that the Army and Navy should be provided with separate establishments."

3. The board repeats its unanimous opinion "that the steel manufacturers should be called upon to provide the material," and recommends—

1. An appropriation of not less than $15,000,000, one-half for the Army and one-half for the Navy, to remain available until expended; provided, however, that none of the money so appropriated shall be expended except in payment for steel accepted and delivered.

2. Proposals to be issued by the War and Navy Departments for bids for the supply of the steel required by each, rough bored, rough turned, tempered, and conforming to specifications. Said proposals shall divide the steel required into two lots. Each lot shall include all the parts for one-half of the number of guns of each caliber. Each bid must include all of a lot or lots. Each bidder shall agree to deliver yearly a specified quantity of each caliber, the time of delivery of the smaller calibers to commence at the expiration of not more than three years from the date of acceptance of the contract. Each bidder shall specify the price of the parts for each of the several calibers. This price may be modified by the Government in equity according to the current rates of labor and material.

3.—Bids, to be considered, must be made by responsible parties, each of which shall certify and guarantee to erect in the United States, in suitable plants, capable of making all the steel required and of finishing it in accordance with the contract.

From personal intercourse with prominent steel makers in the United States, the board is in a position to assert that proposals issued on the above basis will be responded to, but that it will be necessary to appropriate the entire amount recommended in order to induce *responsible* steel manufacturers to erect and complete the plants to produce the steel for the guns needed for the national defense.

The above proposition contains only such a guarantee as would be required by business men embarking in a new and expensive undertaking.

If Congress shall conclude to adopt measures for procuring the supply of guns required, it is essential that its attention should be called to the absolute necessity of appropriating at the same time the $2,000,000 needed for the factories in which the guns are to be fabricated. As it will require at least two years to erect and equip the factories, and many causes of delay may arise, the appropriations for them should be made at the earliest moment, that as much time as possible may be allowed to perfect the arrangements.

It is appropriate to mention here that the annual expense for operating the factories must be determined by the number of tools in use and the quantity of material fabricated, and be estimated for from time to time by the departments. With this exception, the total estimate of $17,000,000 will complete the steel-producing plant, establish and equip the steel gun-factories, supply the guns for six and one-half years, and inaugurate the manufacture of steel in large masses in the United States.

E. SIMPSON,
Rear Admiral, U. S. Navy, President of the Board.
E. O. MATTHEWS,
Captain, U. S. Navy.
THOS. G. BAYLOR,
Colonel of Ordnance, U. S. Army.
HENRY L. ABBOT,
Lieut. Col. of Engineers, Bvt.-Brig. General, U. S. A.
SAMUEL S. ELDER,
Major Second Artillery, U. S. Army.
W. H. JAQUES,
Lieut. U. S. N., Member and Secretary of the Board.

Population and debt of English and American Cities.

Robert P. Porter, in a letter in the Phila. *Press* speaks as follows on the above subject:—

It is safe to say that the smaller cities of the United States, those below 100,000 population have managed their affairs with great prudence. Nearly $500,000,000 of our $697,458,866 of municipal debt may be found in the cities of over 100,000 population. I have prepared a couple of tables giving the population and debt of twenty-one cities in England and of twenty-one cities in the United States. In the latter table I was obliged to include Albany, with something over 90,000 population, in order to make the number of cities the same in both countries.

ENGLISH TABLE.

Cities.	Population 1881	Gross Indebtedness
Birmingham	400,757	$33,948,590
Blackburn	100,618	2,046,645
Bolton	105,973	1,907,025
Bradford	180,459	13,356,345
Brighton	128,407	1,172,210
Bristol	206,503	2,142,665
Hull	161,519	896,640
Leeds	309,126	19,424,895
Leicester	122,351	6,559,015
Liverpool	552,425	22,184,930
London	4,764,312	96,714,500
Manchester	393,676	27,859,415
Newcastle-on-Tyne	145,228	3,593,225
Nottingham	111,631	3,033,550
Oldham	152,511	5,104,445
Portsmouth	127,953	894,820
Salford	176,233	5,877,145
Sheffield	284,410	3,058,965
Stoke-upon-Trent	152,451	265,050
Sunderland	124,960	1,320,955
Wolverhampton	164,303	3,147,605
	8,865,812	$254,508,735

TABLE OF AMERICAN CITIES.

Cities.	Population 1880	Gross Indebtedness
Albany	90,758	4,021,000
Baltimore	332,313	20,184,975
Boston	362,839	42,030,126
Brooklyn	566'663	42,717,500
Buffalo	155,134	7,482,134
Chicago	503,185	13,043,000
Cincinnati	255,139	23,903,500
Cleveland	160,146	8.591,100
Detroit	116,340	2,811,400
Jersey City	120,722	16,388,000
Louisville	123,758	8,979,000
Milwaukee	115,587	2,250,289
Newark	136,508	10,339,000
New Orleans	216,090	15,309,999
New York	1,206,299	136,407,434
Philadelphia	847,170	70,970,042
Pittsburg	156,389	14,826,605
Providence	104,857	9,097,250
St. Louis	350,518	22,507,000
San Francisco	233,959	4,161,500
Washington, D. C.	147,293	21,699,564
Total	6,301,667	$497,720,418

While the aggregate of the debts of the twenty-one largest cities in England do not greatly exceed one-third of the total local indebtness of England, the aggregate of the debts of the twenty-one largest cities in the United States are nearer two-thirds of the total local indebtedness of this country, the per capita debt in the first case being $28.70 and in the second case $78.98. It is safe from this to argue that, while the minor political divisions of the United States have been doing far less in the debt-creating line than the minor political divisions of England our larger towns have been running riot and creating debt much more rapidly than the large cities of the mother country.

There has never been a doubt in my mind that this is due to the much better administration of public affairs in the smaller towns, where, as a rule prominent business men and tax-payers find time to accept local office and discharge the duties. The money in our large cities is expended with little care, and, as a rule, by men who pay but a small share of the taxes. An interesting and instructive document might be prepared showing the amount of taxes annually paid by the men who have the debt-creating and tax-raising power of twenty-one cities in this country, whose aggregate debts are to-day nearly $500,000,000.

Project for a Masonry Tower, 1,000 feet, High.

M. Bourdais, architect of the *Palais du Trocadéro*, has made a design for a tower in masonry 300 m. or about 1,000 ft. high, in the construction of which he associates metal with the stone. He describes it in *Le Genie Civil*.

If a designer would adhere rigorously to the conditions fixed by the crushing strength of the material only, and put the practical limit at $\frac{1}{10}$ of the load which would produce crushing, the following would be possible heights with the material named:—

Porphyry	8,756 ft.	Stone from St. Nom,	908 ft.
Iron	7,872 "	" " Mariv,	580 "
Granite	3,280 "	Banc Royal	328 "
Lias de Bagneux	2,286 "	Vergele	197 "
Stone from Givry	1,312 "		

This table as arranged by M. Bourdais takes into account the resistance and density of the materials, supposing that a pyramidal form is adopted. With a prismatic form the heights would have to be reduced by terraces.

In his design M. Bourdais proposes to go still further by arranging the materials under their best conditions of resistance, with the heaviest and strongest below: as granite and the lias of Bagneux at the base, then the Banc reyal, and finally the Vergele rock.

The exterior profile should be pleasing to the eye, and upon a nucleus of stone the author proposes to erect an exterior metallic framework, decorative in design, and made of wrought iron and beaten copper plates after the method adopted in the construction of the Bartholdi Statue of Liberty.

The tower as projected by M. Bourdais, would have a basement story 216½ ft. (66 m.) high, or exactly the height of the tower of Notre-Dame. This building would serve during the Paris Exposition of 1889, and afterwards, as a permanent hall for the applied sciences, and for electricity especially.

Above this would begin the tower proper, with a least exterior diameter of 91.8 ft. (28 m), five stages or stories would be terminated by a colossal capital. The successive stages, each 115. ft. (35 m.) in height, would be themselves subdivided into three parts, one of 65.6 ft. (20 m.) would be formed of elegant columns, then an attic of 29.5 ft. (9 m.), and finally a kind of band, 19.7 ft. (6 m.) high, surrounding the entire column and pierced with large openings.

The crowning capital, 65.6 ft. (20 m.) high, would be made up with 16 figures, each about 25 ft. high, adorning the exterior. Through the central core of masonry would be a well 58 ft. (18 m.) in diameter, in which would run the elevators giving access to the various platforms and to the top.

To utilize this towering mass, M. Bourdais proposes to surmount it with a powerful electric light, and to direct the rays to the desired points by an ingenious application of parabolic mirrors.

Effect of Subterranean High Temperature in Gotthard Tunnel.

A higher temperature was encountered in the Gotthard Tunnel than in any other work of the kind, though much less than at great depths, as in some of the Nevada mines. In the Mont Cenis Tunnel the maximum reached, as we have seen it recorded elsewhere, was 85° F., and only for about 1600 feet of the center was it as high as 84°. In the Gotthard, for some 3 miles of its length, beginning 2¼ miles from the south entrance in January, 1878, and 3½ miles from the north entrance in May, 1878, the temperature reached 84, and February 29, 1880, when the tunnel was opened through—in winter in the highest Alps—the average temperatnre was 88° throughout the 3 miles. It often reached a maximum of 95°, but usually was not more than 90½°. The air was rarified with moisture, the amount being six to nine times as much as in the outer air.

The effect on the workmen was shown by the following symptoms: Pallor; a yellowish-green color, spreading from the face over the whole body; indisposition to take nourishment; constipation; alternating with diarrhœa; inability to endure muscular effort, palpitation of the heart, weakness, vertigo, catarrh of the organs of respiration and digestion. The number of sick reached the high proportion of 60 per cent. of the whole force; of these, 30 to 48 per cent. got well when they gave up work, while 5 per cent. were not likely to recover. Horses as well as men suffered in the tunnel, and with similar symptoms. The effect of this was to compel an increase of 25 per cent. in the daily wages, a reduction of the hours of labor from 7 to 5 per day, and, consequently, an increase of 100 to 200 per cent. in wages for the same amount of work as was done in the first sections of the tunnel. Further, the amount of work performed daily was reduced, increasing the interest by delaying the opening of the work, and it became difficult to keep up the force at all, as the workmen on the average left after working two months.

It has been calculated by a scientific authority (Dubois-Reymond) that life cannot be sustained in a temperature 122° where the air is saturated with moisture, and it is thought probable that labor becomes impossible in a a temperature of 104°, and the surgeon of the Gotthard Tunnel believes that the limit of subterranean labor was reached there. In consequence of the experience in the Mont Cenis and Gotthard Tunnels, Mr. Stockalper, in the *Revue Generale des Chemins de Fer*, concludes that within a distance 3 miles from one entrance of the proposed Mont Blanc Tunnel a temperature of 122° would be reached; that 3¾ miles from the entrance, where the tunnel would be 9844 feet below the surface, the temperature would reach 128°, and that for nearly 2 miles it would be 115° or above, in which it is doubtful that men could exist, not to say work. He concludes therefrom that artificial means for reducing this temperature and drying the air must be resorted to if this tunnel is to be constructed, for which he proposes, among other things, working the drills with air compressed so as to exert a pressure of about 100 pounds per square foot, the introduction of ice, the circulation of ice-cold water, the use of unslaked lime to absorb the moisture, electric lighting (to avoid foul air), electric or atmospheric locomotives in place of animal power.

It is, however, hardly probable that the work would be prosecuted if the difficulties should be so great. The proposed Simplon Tunnel would probably have a temperature but little higher than that of the Gotthard, and there is no such present need of additional tunnels between Italy and Transalpine Europe as to justify extraordinary expenditures for the construction of one, especially as those which are hard to construct, on account of their atmosphere, are also hard to work.

Tests of Paints Suggested by the Naval Advisory Board.

The Navy Department will test paints, anti-corrosive and anti-fouling compositions, for the wetted surfaces of steel vessels. Samples are invited from makers.

These experiments are undertaken in view of the desirability of obtaining the most efficient anti-fouling and anti-corrosive paints or compositions for covering the wetted surfaces of steel vessels.

Makers or owners of such materials are invited to send samples to the commandant of the navy yards at New York, Portsmouth, N. H.; League Island, Philadelphia Pa., and to Norfolk, Va., before February 1, 1885. Each sample is to be sufficient to cover a suface of 75 square feet, except the sample to be sent to Norfolk, which is to be sufficient to cover a surface 200 square feet in area. The samples are to be marked "Paint Samples for Test," with the maker's name upon the package.

In return the Navy Department guarantees to each person furnishing samples a complete official report of the result of the experiments.

Nothing in the trials or reports shall be considered binding on the Department to accept any of the material for use.

The tests will be made under, as nearly as possible, the same conditions that occur in practice.

The test plates will be of steel of the same quality as that used for outside plating of vessels, each to be 2 feet 6 inches by 3 feet, and to weigh five pounds per square foot.

The plates will be carefully cleaned, dried, and weighed, then covered on both sides with paint or composition, and weighed again.

The plates will also be weighed at each inspection.

Two plates will be covered with each kind of paint, and will be immersed at Portsmouth, N. H., League Island, Philadelphia, Norfolk, Va., and Key West, Fla., and each sample of paint will also be applied in two places to the bottom of some United States vessel, and will be inspected at the same time as the plates.

The makers or owners of paints will please furnish instructions as to the application of their paints, which will be carefully followed. All communications on this subject should be addressed to Naval Constructor S. H. Pook inspector of paints, League Island navy yard Philadelphia, Pa.

The plates will be placed in a cage, insulated from one another, and so buoyed as to be always totaly immersed, care being taken that no galvanic action can be set up with adjacent matter.

If possible, the cages will be moored in positions and currents in which vessels usually lie in the places above mentioned.

The total period of immersion of the test plates will be eight months, and they will also be examined at the end of four months.

No sample will be tested that is not delivered by February 1.

WILLIAM E. CHANDLER,
Secretary of the Navy.

Navy Department, Dec. 16, 1884.

FORTY-FIVE years ago the Britannia was considered a remarkable ship. She was 207 feet long and her tonnage 1,155. The new Cunarder, the Etruria, is 520 feet long and her tonnage nearly 8,000. The Britannia had engines of 850 horse power; the horse power of the Etruria is 14,000. The Britannia carried 220 tons of cargo and 120 passengers; the Etruria 5,000 tons of cargo and 1,500 passengers. The Britannia carried 500 tons of coal and her speed was 8½ knots per hour; the Etruria carries 2,500 tons and makes 19 knots per hour. Five years ago the Arizona made the passage in seven days and seven hours. The builder of the Etruria says she will do it in one day less, and in another five years it will be done in five days.

SELECTED MISCELLANY.

FROM New York to San Francisco by rail is 3,311 miles. In air-line the distance is about 2,600 miles.

A Professor of the Tokio University is about to establish a subterranean observatory in a very deep coal mine, for the purpose of determining the connection between meteorological and earthquake phenomena.

THE oldest geographical society in Europe is the Cosmographic Society of Nuremberg. It was established about 1740, and first came before the public in 1746. It was connected with the Homann institution in the same city.

AT a meeting of the Royal Geological Society of Cornwall, England, Prof. Warington Smyth drew attention to the temperature of deep mines, especially those of Nevada, the great heat of which he ascribed to chemical changes going on in the lode itself.

THE year 1885 is to bring two eclipses of the sun and two of the moon. An annular eclipse of the sun will occur on March 16, invisible in the United States. On September 3, a total eclipse of the sun will take place, visible in Australia, South Pacific Ocean and Cape Horn. This will be followed, on the 24th of the same month by a partial eclipse of the moon, visible in the United States.

THE Statistical Society has published a table showing the railway mileage of Europe, from which it appears that Germany comes first with 51,500 miles, followed by Great Britain, 18,200; France, 17,200; Russia 14,600; Austria, 12,000 Italy, 5,500; Spain, 4,900; Sweden, 4,600; Belgium 2,500; Switzerland 1,535; Holland, 1,435; Denmark, 1,160; Roumania, 920, Turkey, 870; Portugal, 630, and Greece, 6 miles.

LIEUTENANT SCHWATKA is responsible for the assertion that the Yoken River in Alaska is so long that were its source at Salt Lake its waters might empty into New York Bay, and its mouth is so wide that New York would be on one side and Philadelphia on the other. Alaska has a coast line greater than that of all the rest of the United States, adding together the Atlantic Gulf and Pacific seaboards.

THE contract for lightning the town of Liverpool by wick lamps, during the year 1819, was rendered void by the misplacing of a comma in the advertisments, thus: "The lamps at present are about four thousand and fifty, and have in general two spouts each, composed of none less than twenty threads of cotton." The contractors would have proceeded to furnish each lamp with the said twenty threads; but this being only half the usual quantity, the commissioners discovered that the difference arose from the comma following instead of preceding, the word "each."

ROBERT STEVENSON left no family behind. His wife died many years ago, and he remained a widower, so that the direct line from George Stephenson, the eminent engineer, has died out. James Watt, the noted inventor, left no descendants. It appears that the men noted for mechanical genius like many of those famous in literature science and government, leave no children to perpetuate their names. Shakspeare, Milton, Bacon, Newton Harvey, Pope, Mansfield, Pitt, Fox, Grey, Cowper, Collins, Thompson, Goldsmith, Congreve, Hume, Bishop, Butler, Locke, Hobbs, Adam Smith, Bentham, Sir Joshua Reynolds, Sir Thomas Lawrence, Byron, Lord Clyde and others well known to fame have no representatives now living.

DR. LENZ proposed to determine temperatures at a distance by the telephone. Two stations are united by two wires, one of iron and the other of silver, soldered together at both ends. When the soldering of the first station is at a different temperature from the soldering at the second station a thermo-electric current is produced in the wires. If a telphone and interrupter are introduced into the circuit the telephone will speak until the moment when the observer at the second station has raised or lowered the temperature of the soldered junction until it is identical with that of the other at the first station. With wires of bismuth and antimony Dr. Lenz believes that temperature determinations might be made at a distance of 25 kilometer.

SOME have desired to know something about the best kind of safety lamp used in European coal mines. Perhaps the most efficient lamp is the one called the Wolf Safety Lamp. At least it is greatly esteemed in many British and German collieries. It is based like many others on Davy's invention. The flame is protected by case of unusually fine gauze, and is supplied by a light mineral instead of vegetable oil. No soot is formed, and the illumination it affords is steady and brilliant. The wick is made of the substance which goes under the name of mineral wool, which is also employed in the reservoir of the lamp to prevent the oil from coming out. Colliers being in the habit of recklessly opening their lamps, the lock of the Wolf lamp cannot be unfastened without the aid of a very powerful magnet. Should the flame at any time become accidentally extinguished it can be relighted by means of a tape carrying percussion wafers and a hammer, which strikes them, arranged inside the gauze case, and communicating with the outside of the lamp, so as to be operated without unfastening the lock. But this lamp has defects which ingenuity may remedy.

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FIFTY-THREE degrees below zero, at Emerson Manitoba, on December 23, is the lowest record, for the winter so far. This bit of weather has not been exceeded since 1879, when the thermometer at Fort Pembina, in the same locality registered 60° below.

AN odd, but also a reassuring article in the Nicaragua Canal Treaty promises that engineers and others employed on the canal shall be exempt from "forced loans." We suppose that this clause refers to the usual methods of raising funds for chronic revolutionary and other purposes, in the Central American States.

WE publish in our correspondence, this week, a letter from Mr. Gustav Lindenthal, C. E. the designer and builder of several of Pittsburgh's newest and most celebrated bridges. Mr. Lindenthal challenges the statement made in our late article on the repairs to Chestnut St. Bridge in Philadelphia, giving sole credit for the suggestion of iron cylinder struts, used in that connection, to the firm of Anderson & Barr, the present contractors.

We can only say that the claim of Mr. Lindenthal is entirely new to us, and we cheerfully publish his challenge, and will await with interest the outcome of the legal controversy which he says is to follow. Our chief interest was in the idea and its successful application as a new and important departure in the use of compressed air; and, under the existing conditions, we doubt if any plan could have been carried out without it. We gave credit for the original idea as we then understood it; but the application is an important one, and we are always open to conviction. Mr. Lindenthal is already justly noted for his bold engineering projects and novel methods of construction, and if he first suggested this plan of repair, he is certainly deserving of full credit therefor.

The Aqueduct Commission.

At the meeting of the Aqueduct Commission on Jan. 7, Secretary McCulloh stated that the amount raised so far for the Commission had been $450,835, of which $208,478 had been expended. More money will be required to meet the estimates of the contractors soon to come in.

Chief Engineer Church reported that Brown, Howard & Co. had commenced the delivery of material and plant upon the line of their work and had broken ground north of Gould's swamp. Heman Clark was opening shaft No. 24, near High Bridge, and O'Brien & Clark had opened an office at Yonkers, but had otherwise made no demonstration.

Mayor Grace, now President of the Commission, presented a communication received by him from the Municipal Service Examining Board, creating a fourth examining board to whom all applications for positions on the Aqueduct should be referred. The Aqueduct Commission had not yet been officially informed of such action by the Municipal Service Examining Board, and Commissioner Spencer stated that the Commission had been advised by the Corporation Counsel that the civil service regulations did not apply to the Aqueduct Comission, and that while they would cheerfully aquiesce in any practicable plan, they could not proceed under the regulations heretofore existing. The manner of examination and the method of rating adopted by the present examining board were not such as were adapted to the best interests of the Commission in obtaining engineers especially fitted for the work in hand.

Mr. Spencer thought that a test case should be made to determine the exact status of the Commission in this matter and the Commission decided to consult Mr. Lacombe as to the steps required to bring this subject before the highest legal authorities and court of last resort.

London Sewage.

An editorial in London *Engineering* treats of the immensity of the problem of disposing of the sewage in that great metropolis. The evidence of the present Royal Commissioners, presents the Thames as a mere tank of crude unmitigated sewage. To meet the undeniable fact, two remedies only suggest themselves; one is the purification of the sewage at its point of discharge in the river, the other involves its carriage to the German Ocean.

Referring to the sludge left in the precipitating tanks by the first method, *Engineering* says that this amounts to 500 grains per gallon of sewage treated, and consists of about 25 grains of suspended matter, and 20 to 25 grains of lime, while the rest is water. There is thus about one ton of sludge to 30,000 gallons of sewage, or to each one thousand inhabitants. This product is foul, and has little manurial value. If consolidated in a filter-house, it would cost 3s. 6d. per ton, and 900 tons would be produced per diem.

To apply the filtration process on land would require in London about 36,500 acres, if it was intended to convert the fertilizing product into vegetable growth for the food of cattle and man. If purification pure and simple, only be attempted, as by the method of Mr Bailey Denton, in use at Birmingham, one acre per 1,000 or 2,000 inhabitants would suffice and land could be secured. But in consideration of the uncertainty of all purification and filtration methods the journal referred to believes that after all the conveyance of the sewage to deep sea water is the most certain remedy. The cost of outlet sewers and for pumpage would be enormous, but this cost can be estimated with certainty, and the final relief be beyond a question of failure.

Civil Service Examination for Engineers.

We publish to-day a set of questions as used in a late competitive examination of candidates for the position of assistant engineer, by the New York Municipal Service Examining Board.

Civil Service examination is one of the very prominent political questions of the day, and to make the public a little more familiar with its requirements and practical working, especially when applied to civil engineers, is the purpose of the present publication. For the paper published and the general observations on these examinations we are indebted to Mr. J. Woodbridge Davis. C. E., Ph. D., Principal of the School of Mines Preparatory School, and the examiner in Section D on the occasion when we were present.

The Examining Board has its rooms at No. 23 East 20th street, New York. It commenced operations about the middle of January, 1884, and until August 29, following, the examinations were non-competitive, the candidate having been nominated for a certain position before he appeared before the Board. Since the last date the examinations have been competitive, and opened to all citizens of the United States of eighteen or more years of age.

There are at present three Examining Boards, each consisting of three members. The various positions in the municipal government are classified and divided among these Boards. Schedule D includes those positions for which special expert knowledge is required, other than that of physicians, chemists, nurses and those connected with the hospitals and asylums.

The Board which holds its sessions on Monday and Thursday, deals exclusively with candidates seeking positions under Schedule D; and among these are civil and mechanical engineers and draughtsmen. The members of this Board are, Prof. Arthur H. Dundon, Chairman, and Messrs. Daniel B. Smith and James Moir. The examinations commence at 2.30 P. M. and generally last until about 6 P. M.; several afternoons may be consumed in one set of examinations.

On the occasion of our late visit to the rooms of the above Board, during an examination for the position of Assistant Engineer, we found the candidates to be men of intelligence and varying in experience pretty generally with their ages, which ranged from 20 to 50 years. The questions given are contained in the paper printed, and the general observations of Prof. Davis sufficiently explain the practical working of the examination and the standard applied in rating the candidates.

From our own observation, the intention of the examiners is to deal fairly and upon broad, practical grounds with the candidates; giving them the full benefit of their previous experience in actual practice, and taking especial note of their general fitness for an important executive position.

Upon their face some of the questions propounded would doubtless puzzle many an old and experienced engineer; but, with the proviso, that he has access to a working engineering library and can refresh his memory, if he knows where to look up the data, we believe them to be fair enough. Few busy engineers retain in their later years all the mathematical formulæ familiar to the student in his college term. But they should have had at some time a good mathematical training, and at all times should be sufficiently familiar with text books to hunt up the information when required.

Some of the disgruntled candidates have complained through the press of the examiners themselves, and a word upon this head will be in season. Personally we know nothing of the practical field experience of the present Examining Board; we only know several of them as successful teachers of the science of engineering and as the authors of well received text-books upon this subject. But from a general stand point, we do believe that the best examining board for testing the practical status of a candidate for an engineering position, would be one made up of a wise compound of theoretical and practical knowledge of the subject. It will not do for a man who has his knowledge purely from books to dig out some double-jointed problem, that will probably never occur in practice, and hurl it remorselessly at the head of his bewildered victims. The question, that to him, with all his books at his fingers ends, may seem simple enough, may very likely floor the ablest practical engineer appearing before him. But on the other hand, an engineer who has had a life time's experience in one especial groove is as little fitted to test the general knowledge of a candidate. By long familiarity he knows the minutest detail of his own practice; but such a man is very generally much more ignorant than the purely theoretical party of what may be required in the other numerous and widely diverging paths of the profession. Hence we repeat that to obtain the best results, the board should be made up of men who combine the several qualifications of sound, practical experience and a wide general knowledge of the field to be covered; the teacher and the practitioner must be united.

In regard to the practical working of the new system in New York, we will say that among the original candidates for office, appearing before the Examining Board, where the old-time followers of the ward politician, men who knew very much more of the local requirements of a "district boss" than they did of even the expert knowledge of a driver of stakes on an engineer corps. The "papers" of the Examining Board have most effectually routed this class of candidates; and the general public will have the satisfaction of knowing that henceforth there is a possibility of engineers filling city engineering positions.

The entire question of "civil service," as applied to engineers, and the proper method of testing the claims of applicants, is a knotty one and time alone can solve it. In the mean time we are convinced that the Examining Boards mean to deal justly with all candidates, and to correct their plans as experience may suggest.

The International Inventors Exhibition.

The time is drawing very near for the closing of the books to all applicants for space in the above exhibition. And, as Americans are famed the world over, for the inventive genius they have displayed, so they should be well and properly represented in the Kensington display. President Arthur, in his annual message very properly remarks that the field to be covered is one of special importance, and one in which America holds a foremost rank.

In our issue of Aug. 30, of last year, we gave a complete schedule of the class of exhibits expected; and, if the representation of each is in any manner complete, the exhibition cannot fail to be very popular and interesting; and also of paramount value in the knowledge imparted and in material gain to both the visitor and the exhibitor.

We understand that the United States Government will be fitly represented, in a great part by the material now at New Orleans; but the private inventors and makers of all machinery should not fail to contribute their newest, best and most important products. Now that times are called bad and "over production" is the popular outcry, it is just the time to use every honest and practical effort to acquaint foreign lands with the style and possibilities of whatever we have to sell.

The Exhibition opens at Kensington, England, in May of this year, and in the meantime Mr. J. Pierrepont Edwards, Her Britannic Majesty's Consul in New York, will furnish all necessary information and assistance to intending exhibitors.

Annual Report of the Engineer Department of Washington, D. C.

The report of Major Garrett J. Lydecker, U. S. Engineers and Engineer Commissioner, covering the operations of the Engineer Department of the District of Columbia for the year ending June 30, 1884, is received.

In the report of Capt. F V. Greene, Engineer Assistant, the statement is made that the wood pavements of Washington cost over $4,000,000; these have been replaced by stone and asphalt until there is only 69,411 yards still remaining, of which amount only 37,300 yards have yet to be provided for by future appropriations. This wood pavement was a costly experiment, the sum of $1,420,250, having been expended in the last six years in replacing it.

Exclusive of the replacement of wood, the street improvements during the same six years have been as follows:

	Sq. yds.	*Cost.*
Asphalt	48,269.20	$121,584 96
Granite	45,366.91	133,765 52
Asphalt block	2,672.02	7,661 03
Grading and regulating	.....	130,736 68
Artificial stone sidewalk on Pennsylvania avenue	9,872.40	20,486 72

No change has been made in the method of preparing or laying these pavements since the publication of the Washington specifications in this journal last year. The average cost per yard is as follows:—Granite. $2.65; Asphalt, $2.25; Asphalt block, $2.10.

From the report on street repairs, done by contractors to the lowest bidder, it is seen that the actual cost of maintaining 60 miles of smooth surface pavements is about $50,000, or $833 per mile. The number of yards is 1,400,000, and the cost per yard 3¼ cents. The Asphalt pavements, covering 700,000 yards, cost about three-fourths of a cent per yard for annual maintenance.

The paved streets and alleys are cleaned by contract; the streets are cleaned once a day to once in two weeks, depending on the traffic; the alleys in similar times depending on the season. The contract price for street cleaning last year was 29¼ cents per 1,000 square yards, and for alley cleaning 40 cents for the same area. Prices for the current year are the same for street cleaning, and 42½ cents for alleys.

A topographical survey of the District is now in progress under the direction of J. W. Donn, assistant in the Coast and Geodetic Survey. Nine square miles have been mapped on a scale of 400 ft. to the inch ($\frac{1}{4800}$) and are photo-lithographed in 7 sheets.

In connection with this survey, during the past season the four corner monuments of the District, as established by Ellicott in 1791, were identified and located. It was discovered that the District is not exactly a ten-mile square, the length of the four sides being as follows:

S. W. 53,031.3 feet, or 231.3 feet too long.
S. E. 52,871.3 feet, or 71.3 feet too long.
N. W. 52,863.6 feet, or 63.6 feet too long.
N. E. 53,063.8 feet, or 263.8 feet too long.

The total area of the original District was 100.6 square miles. The north point is 116.6 feet west of the meridian of the south point, and the east point is 138.6 feet south of the west point. Considering the character of the instruments with which Ellicott made his survey, and the nature of the country, then practically a wilderness, through which he ran his lines, one cannot but be surprised at the accuracy of his results.

In regard to burying the telegraph wires, of which there are 285.$\frac{33}{100}$ miles in the city, the W. U. Telegraph Co., with one half the mileage, is neglecting to take any steps in this direction. The Telephone Co. last spring laid 400 conductors underground at a cost of $35,000, and has just obtained a permit to lay another line of about 1¼ miles with 500 conductors underground at a cost of $65,000. The Brush-Swan Electric Co. has also a permit to lay about three miles of underground wire on Pennsylvania Avenue; and the U. S. Electric Co. has a similar permit for about one mile on F Street. At the close of this year (1884) there will thus be about 300 miles of underground wire for telephone, telegraph and electric light purposes in full and successful operation.

The subject of the sewers of Washington is treated very fully, and we will give in this journal the standard sections, specifications and other data as obtained from this report.

The total expenditure for the water department of the District was $109,337.77, and the daily consumption has been reduced, by a rigid inspection, from 29,727,864 gallons in 1882, to 24,827,013 gallons in 1884.

E. J. De Smedt, General Inspector of Cement and Asphalt Pavements, reports upon the analysis made to him as follows:—The average percentage of asphalt cement in 175 samples is:

Chemically pure asphalt cement	9.00 Commercial 13.50
Ca O C O², carbonate of lime	8.00
Silica	83.00
	100.00

The average composition of asphalt blocks is:

Asphalt cement, chemically pure	7.50
Broken stone, Ca O C O²	92.50
	100.00

The Cumberland Cement is reported against as not furnishing as good a quality of slow setting cement as formerly, for reasons unknown. Chemist De Smedt classifies Potomac as of better quality than average Rosendale, but speaks of the "Union" brand of hydraulic cement as giving thus far excellent results; this is a cement partially made on the system of Portland cement. It does not compare with good Portland cement, but is far superior to ordinary home-made cements.

The Inspector speaks as follows of the "Theory of Setting" of hydraulic cements:—

The setting and hardening of the hydraulic cement rests principally upon the hydration of the silicates, viz., formula: $5\,CaO, 3SO^2 + 5\,H^2O$. In products which like puzzuolana, harden after the addition of milk of lime, there exists free, hydrated silica, which combines with lime to the given limits by the preceding formula The hardening of the hydraulic cements depends also on the formation of hydrosilicates of magnesia, alumina, etc. I have given the preceding formula only to be better comprehended, and prove that the presence of water is necessary to the hardening of a hydraulic cement as a cement, and to show how the analysis will predict the quality of hydraulic cement; in other words the quality of a hydraulic cement depends entirely upon its purity; and the more nearly the composition of the chemical formula is approached the better the cement will be, provided the calcination has been performed in conformity to the composition of the raw material.

The process adopted by the office is as follows; The cement is, in a given proportion, mixed with water, in sufficient quantity to make a stiff paste, it is formed into $\left(\frac{\square}{\square}\right)$ shaped briquettes, the cross-sectional area of the central portion being one square inch. As soon as thus formed, it is removed from the mould and exposed to the air until set; that is, until it can be handled without danger of cracking; it is then immersed in a water bath, and the briquettes are at different intervals taken directly from the water, and, without being dried, are broken in a Fairbanks machine.

There are numerous reasons why the briquettes should be broken while wet, of which I will state a few, which will be sufficient to show the importance:

1st. The hydraulic cements set, as shown by the preceding formula, by the hydration of silicates in the presence of water. Therefore, the entire absence of water stops the setting of the cement by hydration.

2d. The cement may contain uncombined, clayey, inert substances, which, when moisted, compacted, and then dried, may have a great cohesion, thus showing a great tensile strength, which tensile strength is, in part, lost when afterwardr brought in contact with water. In such case, the original test, by breaking the briquette dry is a deceptive one, differing materially in its results from that produced by breaking it wet.

3d. Hydraulic cements frequently contain an excess of free lime; if so, they will crack when immersed in water; the cracking is, however, often not perceptible

for several days after the immersion. In such a state the cement ought to be rejected.

4th. Hydraulic cement is intended to be used in underground foundations, sewers, water conduits, etc., where it remains moist or wet. For that reason alone it seems important that hydraulic cement should be tested as to its tensile strength while wet, and as much as possible under the same condition when finally used. Therefore, where the cement is to be used in submarine works, the briquettes, on account of the difference in the composition of sea water, ought to be immersed in that kind of water taken from the locality where it is to be used, in order to ascertain the chemical effects of the compounds of this water on the cement, which may be detrimental to certain brands and not to certain others.

In testing hydraulic cements the chemical analysis is the true indicator of its quality, and whenever more than 1.50 per cent. of sulphuric acid is found in a hydraulic cement, it should be rejected, as such cement will crack after being used, and will disintegrate after being several months in water.

Maintenance of Public Works, New York vs. Brooklyn.

At a meeting of the Council of Reform, for New York, last week, Mr. Henry N. Beers, in criticising the estimates of the Departments of Park and Public Works, makes a comparative statement of the cost of some of the public works of the Cities of New York and Brooklyn, "taken wholly from the public documents." We give this stat ment as follows, with the caution that we have not compared the items with the documents," and that the character of the work compared varies very much in the two cities:

REPAIRS AND MAINTENANCE OF THE AQUEDUCT.

New York—Length of Aqueduct, 42 miles; dimensions, 7×8 feet.

Brooklyn—Length of Aqueduct, 13 miles; dimensions, 8×10 feet.

New York—Amount asked for for 1885, $250 000; cost per mile, $5,333.

Brooklyn—Amount spent for in 1883, $12,652; cost per mile, $973.

MAINTENANCE OF BOULEVARDS AND AVENUES.

New York—Area, of 203 acres; amount asked for, $133,000; cost per acre, $645.

Brooklyn—Area of, 226 acres; amount spent for 1883, $22,512; cost per acre, $99.

REPAIRS AND RENEWALS OF PIPES, STOP-COCKS, ETC.

New York—Length of Pipes, 558 miles; amount asked for, $313,750; cost per mile $517.

Brooklyn—Length of Pipes, 366 miles; amount spent for in 1883, $49,464; cost per mile, $135.

New York—Number of Meters, 10,118; number of Inspectors, 61.

Brooklyn—Number of Meters, 1,948; number of Inspectors, 4.

New York—Number of Meters to an Inspector, 165; asked for Inspectors, $57,148; cost per Meter, $5.64.

Brooklyn—Number of Meters to an Inspector, 487; spent for in 1883, $3,900; cost per Meter, $2.

REPAIRS AND RENEWALS OF STREETS AND ROADS.

New York—Length of Streets, 326 miles; amount asked for, $825,000; cost per mile, $2,531.

Brooklyn—Length of Streets, 332 miles; amount spent for in 1883, $78,108; cost per mile, $235.

SALARIES FOR PUBLIC WORKS.

New York—Amount asked for, $166,000; per capita cost, 35 cents.

Brooklyn—Amount spent in 1883, $63,000; per capita cost, 9¾ cents.

CLEANING AND REPAIRING SEWERS.

New York—Length of, 411 miles. Amount asked for, $174,297. Cost per mile, $424.

Brooklyn—Length of, 302 miles. Amount spent in 1883, $47,879. Cost per mile, $1.25.

CLEANING AND SUPPLIES OF PUBLIC BUILDINGS.

New York—Area of, 237,924 sq. ft. Amount asked for, $137,000. Cost per sq. ft. 57½ cents.

Brooklyn—Area of 118,500 sq. ft. spent for in 1883 $8,719. Cost per sq. ft. 7¼ cent.

TOTAL COST OF THE GOVERNMENT.

New York—Asked for for 1885, $36,752,758. Per capita cost, $27.

Brooklyn—Spent for in 1883, $7,808,633. Per capita cost $12.

TOTAL AMOUNT OF SALARIES.

New York—Asked for for 1885, $12,105,499. Per capita cost, $9.

Brooklyn—Spent for in 1883, $1,560,292. Per capita cost, $2.30.

TOTAL AMOUNT FOR CLEANING STREETS.

New York—Amount asked for, $1,642,550. Per capita cost, $1.21.

Brooklyn—Amount spent for in 1883, $76,823. Per capita cost, 11 cents.

TOTAL COST OF STATIONERY, ETC.

New York—Asked for for 1885, $157,300. Per capita cost, 11 cents.

Brooklyn—Spent for in 1883, $10,689. Per capita cost, 1½ cents.

New York, Dec. 26, 1884 JOSEPH NOBLE STEARNS, of the Council of Reform

PERSONAL.

JOSEPH F. TUCKER, formerly traffic manager of the Illinois Central R. R., is spoken of as Vice Pres. of the Erie R. R. MR. TUCKER declines.

GENERAL HIUDEKOPER, Postmaster of Philadelphia, and President of the Western Car Co., is prominently mentioned for General Manager of the Phila & Reading R. R.

GEORGE WESTINGHOUSE, father of the inventor of the Air-brake, died in Pittsburg on Dec. 29, aged 75 years.

COL. JOHN C. PARKE, Corps of Engineers, will take charge of the office of the Chief of Engineers during the absence of that officer.

E. W. MEUNSCHER, C. E., of Grand Rapids, Mich., was elected County Surveyor of Kent County, Mich., November 4th, by a large majority.

T. M. R. TALCOTT, formerly Vice-President of the Richmond and Danville Railroad, has been made Vice-President and General Manager of the Mobile and Ohio Railroad.

R. J. EVANS, has been appointed by the Receiver, Chief Engineer of the Memphis, Salina & Brunswick R. R., W. P. Dunavant was at the same time made Superintendent of Construction.

A. H. HARRISON has been appointed by President Garrett, Master of machinery of the Balt. & Ohio R. R. Trans-Ohio Div., with headquarters at Newark, Ohio.

A. V. MILLS, of Pittsfield, Ill., has just been elected President of the Sny Levee Commission, of Illinois. An effort will be made to have Congress appropriate the sum of $50,000 required to raise this levee two feet to insure its security.

THE salary of H. M. WIGHTMAN, City Engineer of Boston Mass., has been raised from $4500 to $6000 per annum. MR. WIGHTMAN having been placed in charge of the Engineering of the Water Department, Improved Sewage, Parks, Bridges and other public works of the city, the increased salary is well merited.

W. K. ACKERMAN, late President of the Illinois Central Road, has been appointed General Western Representative of the Baltimore and Ohio Railway, with headquarters in Chicago. He will have nothing to do with the conduct of the road, but will look after its more important interests in the West.

LIEUT. ABERCROMBIE of Gen. Miles, staff, has just returned from Alaska, where he has been engaged in Government explorations. He explored the Yukon River, for 2,700 miles, and reports rich placers for 1,000 miles up, but the season is short and mining difficult. The Lieutenant says the fisheries are the finest known.

COL WM. LUDLOW, retiring President of the Engineers Club of Phila. will deliver the annual address to night. The ticket for officers for the year 1885, to be opened at the same time, is as follows: Prest. J. J. de Kinder; Vice Prest., Jos. N. Dubarry; Secretary and Treasurer, Howard Murphy; Directors, T. M. Cleeman, Frederick Graff, Rudolph Hering Wm. Ludlow, Henry G. Morris.

A. R. FAUNT LE ROY, Assistant Engineer of the Chicago, Milwaukee & St. Paul R. R., died in Milwaukee on Jan. 2. Mr. FAUNT LE ROY was a grandson of Robert Owen and a nephew of Robert Dale Owen. He was connected with the coast survey during the late war, and distinguished himself in connection with the torpedo service in Charleston Harbor. He was connected with the Phila & Read. R. R. about 1870.

THE American Metrological Society held its annual meeting on Dec. 30. The following officers were elected: President, Dr. F. A. P. Barnard, president of Columbia College; vice-president, J. E. Hilgard, superintendent United States Coast and Geodetic Survey; corresponding secretary, Dr. A. M. Mayer of Stevens Institute, Hoboken; recording secretary and treasurer, John K. Rees, director of the Columbia College Observatory. Several important reports were received from various committees.

W. HASELL WILSON, consulting engineer of the Pennsylvania Railroad, and President of the Philadelphia and Erie and other companies, has been longer in active and important railway service than any other man at present living. MR. WILSON'S entry upon railway work dates back as far as 1829, when he served as a rodman in the engineer corps engaged in surveying the Philadelphia and Columbia Railroad. From that time to the present he has been almost constantly and prominently identified with the various railways now included in the Pennsylvania Railroad system, rising from the position of rodman through the various grades of assistant engineer, principal assistant engineer, chief engineer, etc., to the very responsible office now held by him.

DAVID LOWBER SMITH, late First Assistant Engineer in the New York Department of Public Works, under Commissioner Thompson, has been appointed Deputy Commissioner of Public Works by the new Commissioner, Mr. Squires. MR. SMITH was born in New York, is 39 years old, graduated from the College of the City of New York in 1866, and from the School of Mines in Paris in 1869. From 1870 to 1878 he was Assistant Engineer of the Brooklyn Water works. In the last year he was appointed Assistant Engineer in the Department of Public Works of New York, by Commissioner Campbell, and constructed two sections of the Bronx River water supply. In Nov. 1883, Commissioner Thompson made Mr. SMITH Water Purveyor, and a short time ago appointed him First Assistant Engineer of the Department.

Improvements in Heavy Guns.

Colonel J. B. Haskins, inventor.—The manufacture of heavy guns is in its infancy. It is true that improvements are made from time to time in their construction, but they apply to details, rather than the principle upon which guns are built. There is but a little modification of the principle of the old brass piece of the last century seen in the 100-ton guns of to-day. There is the same general loss of power in each. A pressure of 40,000 pounds at the breech of the best gun in the market will diminish, 6,000 pounds at the muzzle, with a corresponding decrease in the velocity of the projectile. What gun makers are striving for is to make a gun in which the high pressure at the breach will be maintained to the muzzle, and to discharge a shot with this tremendous pressure behind it. When this result is attained the heaviest fortification and armor will shrink into insignificance, and a city or a vessel will be battered to pieces the same as if it were an egg-shell. The time I believe, is not far distant when a gun of this power will be made. The harbor defences of the world will then have to be changed, and the most powerful men-of-war will, comparatively speaking, be nothing more than pleasure yachts.—*N. Y. Tribune.*

THE smallest steam engine in the world is now claimed by the Toronto *Globe* to be the production of a resident of Arkona, Can. The *Globe* says: "The dimensions of this miniature affair are as follows. Diameter of cylinder, ½ of 1-16 of an inch: stroke, 1-32 of an inch; weight, ½ of a grain, bore of cylinder, .3125 of a square inch; revolution, 1730 per minute; horse power, .12490 part of a horse power. This engine is so small that it can easily be covered with the case of a 22-calibre cartridge.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 296. Vol. 12.*)

Rails and Joints.—There is no part of a railroad that has undergone such a complete change in material, form and fastenings as rails. Without attempting to give the detail, from a historical point of view, of the various processes of manufacture as scarcely entering into the scope of the present paper, we hastily sketch the steps of progression in form at least. The first tramways were of wood or stone, then was introduced the cast iron rail of L pattern, to be suceeded about 1805, by the cast iron "fish-belly" type in length of four or five feet supported on cast iron chairs; which was in turn superseded, about 1820, by the well known "strap" rail, notable as the first attempt at rolling the iron into shape for this purpose. The strap rail was a flat bar of rolled iron, of various sections, spiked down to a longitudinal wooden stringer and is chiefly remembered for its unpleasant tendency towards the formation of "snake-heads," so called, the ends curling up and at times going through the floor of the car.

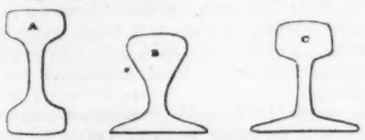

FIG. 35—RAIL SECTIONS,

The first form worthy of the name of rail from a modern standpoint, is the "double-head," shown in Fig. 35 A. A shape was thus obtained possessing sufficient vertical strength to permit its use as a girder between supports; having lateral stiffness, and supposed to be advantageously adapted to turning when one head had worn out. The double-head rail, in various modified forms, is still very largely used on the continent of Europe and especially in England where it is supported on each tie by a heavy cast-iron chair.

The next advance was the flat bottomed rail introduced by the English Engineer Charles Vignolles about 1831, and since known by his name. As this is the type now in exclusive use in the United States we will confine ourselves solely to the consideration of this especial pattern. The advantages over the double headed rail are economy of material, simplicity of joint fastening, and the rejection of the cumbersome cast iron supports.

At first the section adopted was that shown in Fig. 35 B, called the "Pear" pattern. These rails were supported at the joints by cast or wrought iron chairs; but as this shape was not well adapted to heavy service on account of the difficulty of attaching proper fastenings, further experiments were made and after trial with various sections and investigation of rate of wear on both rail and wheel the present style of rail, Fig, 35 C, was finally determined upon. In this later form the material is located with a view to its proper and economic disposition for service, and with minor modifications it has been almost universally adopted.

The divisions of a rail are the "head," "web" and "base," or, as they are generally termed by the trackmen, "ball," "neck" and "foot." In proportioning these parts as much material as possible is concentrated in the head to withstand wear; the web is so arranged that with a given amount of metal the depth or vertical stiffness of the girder is a maximum and the thickness a minimum; and the base should be as broad as possible so as to provide a good and sufficient bearing area and a greater resistance against lateral deflection.

In the earlier stages of rail manufacture bars of iron were placed in layers forming a "pile" and then heated and passed through a graduated series of rolls until the final rail section was obtained. The resulting rail was thus composed of many welded parts, more or less perfect in their union. As the traffic and the weight of the rolling stock increased, these wrought iron rails began to give trouble by splitting and more especially by the lamination of the head. To meet this then serious objection "steel" rails were introduced about 1857 and under the Bessemer process of 1862 the manufacture was rapidly developed and the cost of production reduced. These so called steel rails are simply a high grade of homogeneous iron rolled from solid ingots and consequently without the objectional weld. Until the introduction of the Bessemer process the cost of production and the distrust of the new metal brought into the market an iron rail with a steel cap which was expected to meet all requirements; but actual use developed the impossibility of making a perfect union between the iron and the steel.

Improvements in the Bessemer process and the invention of the Siemens-Martin method of manufacture soon and rapidly decreased the cost and made it possible to furnish the steel rail which at this date has entirely supplanted iron. It is an undeniable fact that to this invention of Henry Bessemer is in a great measure due the present marvellous growth of the railway system of the world.

As regards weight and size of rail required, the minimum weight economical in practice is 60 lbs. per yard with a base of 4 inches. This is sufficient for roads doing a light or exclusively freight business; many roads, especially in the southern States, are being run with lighter rails than this, but the diminished life of the ties and the increased cost of maintenance more than counterbalance the extra cost of heavier rails. A 63 to a 65 lb. rail will answer for heavy freight and good passenger traffic, while for extra heavy service with very fast passenger trains a 67 or a 72 lb. rail is needed. The heavy rails do not bend so easily, the joints do not sag so quickly, and the track stays in much better line. Of course a heavy rail requires more men in a gang to handle it and to throw the track, but when once in place it is more permanent. Another and considerable advantage is the broader base and consequent increased bearing upon the ties, for as mentioned previously these ties succumb as often by being cut out as by being rotted out; therefore the rail base should be broad and rounded at sides as shown in the Penna. R. R. pattern, and not brought to a sharp edge as in the majority of rail types.

[The portion of "Track" appearing in this issue should *precede* the matter printed last week. In the confusion attending the many changes required in our first number, the wrong "copy" was sent in. The matter in the issue of Jan. 3rd will be republished so as to correct the numbering of the illustrations.—ED. ENG. NEWS.]

(TO BE CONTINUED.)

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CORRESPONDENCE.

Correction.

NEW YORK, Dec. 20, 1884.

EDITOR ENGINEERING NEWS:—In the interesting article on "Punching Holes in Soft Steel" published in your journal of December 13, I note an error of translation. 600 *pounds* are given as 9⅓ tons, and a similar error in another place. The word pound should be printed "*pood*." The Russian pood is equal to 36 avoirdupois pounds, and 600 poods are quite closely 9⅗ tons of 2,240 lbs. each. F. COLLINGWOOD.

Repairs to Chestnut St. Bridge.

PITTSBURGH, PA., JANUARY 5, 1885.

EDITOR ENGINEERING NEWS.—Your issue of January 3d, 1885 contains an article on the "Repairs to the Chestnut St. Bridge in Philadelphia, Pa.," in which occurs the following statement: "In this emergency, Mr. John F. Anderson, of the firm of Anderson & Barr, Engineers and Contractors, suggested to the city authorities the use of iron cylinder struts, extending from the foundation masonry of the west main abutment to the bedrock, and thus disposing at once of the mischief-making thrust. Plans were accordingly adopted from his designs."

In reference to this I beg to say, that the use of cylinder struts in this instance did not originate with Mr. Anderson or any one else, except myself. Suits are now pending against the city of Phila. and against Mr. Smedley, for the unauthorized use of my plan, modified though it had been.

There will be ample and proper opportunity in court for substantiating any claims, that may be made, and for getting at the truth in this matter. It is therefore useless, for me to say anything more on the question at this time.

I make this statement merely to show, that Mr. Anderson's alleged authorship of the plan is not unchallenged.

G. LINDENTHAL, C. E.

Creeping of Rails.

N. Y. & NEW ENGLAND R. Co.
CHIEF ENGINEER'S OFFICE,
BOSTON, JAN., 7, 1885.

EDITOR OF ENGINEERING NEWS.—I have been much interested in the article in the last NEWS about the creeping of rails on St. Louis Bridge.

If each rail was fastened to the ties by angle bars, as referred to in the article, at each end and the middle of each rail, without having the rails fastened together by any splice bars, would not the creeping be stopped without bringing any appreciable strain on the trestle or bridge.

If a heavier rail, say 72 lb. rail of good pattern were used would not the inclination to creep be greatly reduced?

H. C. K.

[Our pages are open to the discussion of this interesting and important problem.—ED. ENG. NEWS.]

American Society Civil Engineers.

At the meeting held Wednesday evening Jan. 7, Col. Wm. H. Paine presiding, the following persons were declared as elected to membership:

MEMBERS: Peter Lather Archibald, Chief Engineer, Maintenance of Way, Intercolonial Ry., Moncton, New Brunswick, Canada; Charles Sumner Henning, Resident Engineer in charge of Maintenance of Way, Atlantic and Pacific R. R., Peach Springs, Arizona; Charles Maples Jarvis, Vice-President and Chief Engineer, Berlin Iron Bridge Co., East Berlin, Conn.; Henry Ward Beecher Phinney, Resident Engineer, Harlem River Bridge, Suburban Rapid Rapid Transit Co, New York City;

JUNIORS.—William Ferris Booth, C. E., Poughkeepsie, N. Y.; Edward Flad, Ass't Engineer, St. Louis Water Works, St. Louis, Mo.; Sinclair Joseph Johnson, Ass't Engineer Harlem River Bridge, Suburban Rapid Transit Co., New York City.

The following amendment to Section 19 of the By-Laws of the Society was adopted by a general vote.

SECTION 19.—A nomination or proposal shall be presented at the next regular meeting of the Board of Direction following its receipt; *the Board of Direction shall thereupon send to all members of the Society a notice that such person is a candidate for election. Not less than thirty days thereafter the Board shall consider the application, and if approved* and the applicant (if for admission as Member, Associate or Junior) classed with his consent, a day shall be fixed for the ballot to be canvassed, which shall be at a regular meeting of the Society, not less than twenty-five days thereafter.

The amended portion is in italics.

The paper of the evening was by Prof. Robt. H. Thurston, on "The Real Value of Lubricants and the Correct Method of Comparing Prices;" this paper was read by the Secretary and discussed.

Mr. M. Eisler. C. E. followed with an interesting description of the geology of the Isthmus of Panama, as found along the line of the Canal. Mr. Eisler referred especially to the disintegrated character of the trachite rock as found at the depth of 33 *metres* below the surface at the Culebra, and gave his theory for this formation.

Mr. H. C. Y. Möller, C. E., Asst. City Engineer of Copenhagen, Denmark, exhibited maps of the harbor of Copenhagan and described the harbor works.

After adjournment the usual collation was served in the Society house.

Engineers' Club of Philadelphia.

Record of Regular Meeting, December, 20th, 1884.

Past President Frederic Graff in the chair; 35 members and 3 visitors present.

Mr. Geo. S. Strong read a portion of the first of a series of papers upon the Future of Locomotive Building. It contained a review of the present and past fast train service in Europe and America, with a discussion as to the possibilities of the future, under the following headings. Fast Express Trains in England. Fast Express Trains on the Continent. Fast Express Trains in America. In all of these the journey speed and running average is given. Are Still Higher Speeds Wanted? Recent Multiplication of Freight Traffic on American Railways. Train Resistance. Resistance of Grades. Resistance of Curves. Atmospheric Resistance. Have We Reached the Maximum Speed in Our Locomotives? The Boiler Power Difficulty. Possible Ways Out of the Boiler Difficulty. Economy of Fuel. English *vs.* American Locomotives. Comparative Cost of Slow and Fast Traveling. This and the following papers are intended to be a complete analysis of the problem of rapid train service, both passenger and freight, and of the locomotives now employed in such service; and a consideration of the form and characteristics of the engines which must meet prospective demands. Methods of construction, shop practice and the necessity for more uniformity in standards, are among the important topics.

Gen. Russell Thayer read a paper upon the Navigation of the Air, with a Description of the Aerial Ship and the Theory Practical Operation of its Motor. A review is given of various theories and experiments in the matter of propulsion since the discovery of the balloon, and the conclusions which have been reached as to the main principles involved in the problem. He considers propulsion by wings impossible, and that the motive force must come from within the machine itself. The motor, he described as consisting essentially of a reservoir, into which compressed air is forced, or steam is allowed to flow until the required pressure per square inch is obtained. The rear end of this reservoir is so arranged that, at given intervals of time, the confined energy is suddenly released, thus producing a powerful motive thrust forward, due to the fact of the unstable condition of equilibrum of forces at the instant of discharge. The amount of power thus rendered available is dependent upon the size of the cylinder end and its discharge. It is also, of course, a function of the time of charging and the number of strokes of the engine made therein. In the motor here described for aerial navigation, the impact of the escaping air, gas or steam, under high pressure against the particles of the surrounding air in which the body is floating, tends to increase the resultant action forward, but the principal portion of the motion forward is caused by the continuous condition of unstable equilibrum of forces producing a resultant action, as above described, in a given direction. The reaction resulting from the impact of the escaping gas upon the particles of the surrounding medium, is small in comparison with the resultant of the forces in unstable equilibrum, but slight as it is, it acts in the proper direction.

The ship itself consists of two portions: the buoyant part, which corresponds to the hull of a water ship, is made of supposed tissues of strong silk and rubber, and the shape is that of a circular spindle, in which the long horizontal axis = 3½ times the length of the diameter amidships; this structure is filled with hydrogen gas. The deck of the ship, upon which the machinery is placed and where passengers can be accommodated, is below the buoyant part of the structure, and is firmly supported therefrom and braced thereto. Opposite the center of the ship there is a lower deck, completely enclosed and separated from the rest of the structure in which the source of power is located. From the motor a pipe leads all or part of the wasted energy utilized in the production of motion to the stern of the ship, and is there terminated by a nozzle fitted on a ball and socket joint. This arrangement permits the nozzle to be moved in any direction at pleasure, and by a movement of the nozzle from the wheel, the ship may be steered in any direction that may be desired, thus avoiding the necessity for any rudder. While the machinery is in motion and the force is being generated, the aerial ship is under perfect control and can be directed in any course that may beq uired.

Mr. Lloyd Bankson presented, for Mr. H. W. Spangler, an illustrated paper upon Measuring Chimney Draft. The ordinary method of measuring is by means of a U tube, partly filled with water. The difference in level in the legs of the U is a measure of the amount of chimney draft. When this is small it is desirable to magnify the reading, and several devices were described for the purpose. One, devised by Mr. Barrus, consisted of two vessels connected by a U tube, the vessels being filled with liquids of about the same specific gravity, but of different colors. The line between the liquids which could be seen in the U tube moved with the amount of draft much more than it would have done in a simple U.

Another device consisted of two vessels of different sizes, each covered with a diaphragm of rubber. These diaphragms are connected together. The inner side of one vessel is connected to the chimney, while the inner part of the other connects with a glass tube and is filled with water. The water rises and falls in the tube with pressure in the chimney.

The Secretary presented, for Mr. P. A. Taylor, an account of the enlargement of the East Mahanoy Tunnel, East Mahanoy Railroad, Schuylkill County, Pa. This tunnel is 3411 ft. long, and was completed during the year 1862.

In the spring of 1876 it was decided by the Philadelphia & Reading Railroad Company to enlarge it on account of its being too low to permit the passage of engines having the standard height of smoke stack adopted by the company.

To do the work it was first thought that a sufficient amount of the roof could be taken off, but on account of slips and falling rocks, caused by the fact that when the tunnel was driven, several of the coal measures were cut through; it was particularly dangerous and necessitated timbering in some places; the risks also of detaining trains by having the necessary false works in the tunnel to reach the roof, were great, and the coal trade being particularly brisk at that time, the idea was abandoned, and it was decided to take out the bottom, a portion of one side and a part of the bench that had been left in originally by the East Mahanoy Railroad Company.

On May 29th, 1876, the work was started, and finished September 9th of the same year, costing about $41,000.

The length taken out was 3,411 ft., average depth 2 ft. and width 12 ft.; all of which was through conglomerate rock, known only in the anthracite region. In addition to taking out the bottom, various points of the roof had to be taken down, as well as on the sides of the tunnel, as noted above.

A force of about 225 men was employed in the work, one-half working during the day drilling holes for the blasts and getting everything ready for the explosion of the shots, which generally took place about ten o'clock at night, after the fast Centennial Express through. The night force was employed in blasting. No. 2 dynamite was used, and 100 shots put off at one time, by electricity. The debris was then cleared away, and the track blocked up to allow trains to pass through. From ten o'clock until two o'clock, during the night, was the only time that trains entirely ceased to run through the tunnel.

They labored under great disadvantage for the want of proper ventilation. The shafts which had been sunk during the construction of the tunnel had been filled up for some years, and the smoke caused by the numerous trains passing through, as well as that produced by the blasts, had to seek an outlet at the east and west ends of the tunnel.

During the whole progress of the work but one train was delayed, and that only five minutes, and the only accident that occurred was the killing of one laborer, caused by his falling under the small engine which was used for hauling away the small trucks loaded with debris from the tunnel.

In the grades of the original road-bed of the tunnel there was a slight adverse grade from the west end to a point about midway, causing the water, percolating through the seams of the coal measures, to drain partly into the Susquehanna and partly into the Delaware. Now there is a continuous grade with the trade, relieving a heavy pull of the loaded coal trains after entering the tunnel.

Mr. John C. Trautwine, Jr., presented an illustrated description of a design for a 100 ft. turntable, by Mr. C. O. H. Fritzsche, of New York, for the N. Y., W. S. and B. R. R. Co., for use in their car shop. It was to carry a six-wheeled shifting engine, 30 ft. long, weighing 90,000 lbs., and two cars, each 36 ft. long weighing 24,000 lbs. each: total extraneous load, 138,000 lbs.

The table is turned by a steam engine, which, with its boiler, is carried upon an iron platform, about 7½ × 13 ft., attached to one side of the turntable near the middle of its length and thus revolving with it. The power of the engine is communicated, by means of bevel gearing and a long shaft running along the center-line of the turntable, to a wheel in each end carriage.

HOWARD MURPHY,
Secretary and Treasurer.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

Continued from page, 15.

DCCIII. BLUE ISLAND, ILL.

Blue Island, Cook County, Illinois, in lat. 41° 50′ N. long. 87° 50′ W., is 16 miles west of Chicago on the Chicago, Rock Island & Pacific R. R. Water-works were built by the village in 1876, taking the supply from a well, and pumping, by steam, into a tank holding 60,000 gallons, on a stone tower 50 feet high. Distribution is by 3 miles of cast-iron pipe, with 30 taps and 35 fire hydrants. The works cost $20,000. The bonded debt is $10,000 at 6 per cent. interest. The annual cost of maintenance is $800. The revenue is not given. John Stoffel is Chairman of the Water Committee, and L. Leichtmeyer, Secretary.

The population, in 1880, was 1,542.

DCCIV. BOONE, IA.

Boone, Boone County, Iowa, in lat. 42° N. long. 94° W., is on an elevated rolling prairie two miles, west of the Des Moines River. Settled in 1864, it was incorporated a city in 1866. Water-works were built in 1883-4 by the city, after plans of T. N. Boutelle, taking the supply from an artesian well, yielding 54,000 gallons a day, the water from which is pumped by a steam pump constructed by G. C. Morgan, into an iron tank holding 60,000 gallons on a brick tower 110 feet high.

Distribution is by 2 miles of cast-iron pipe of 8, 6 and 4 inches diameter, with 16 fire hydrants. The works were completed in August 1884, at a cost of $19,000. George H. Welsh is Chairman of the Water Committee.

DCCV. BRAINERD, MINN.

Brainerd, Crow Wing County, Minnesota, in lat. 46° 15′ N. long. 94° 15′ W., is on the Mississippi River.

Water-works were built in 1883 by a private company taking the supply from the Mississippi River and pumping directly into the mains, by a G. F. Blake Duplex condensing steam pump with 18 inch steam and 10 inch water cylinders, of 12 inch stroke.

Distribution is by 11 miles of cast-iron pipe with 61 hydrants and 200 taps. Service pipes are of wrought-iron. The city pays $75.00 per year for each fire hydrant. The population, in 1880, was 2,319. O. H. Huvill is Secretary.

DCCVI. CANTON, ILL.

Canton, Fulton County, Illinois, in lat. 40° 40′ N. long. 90° 5′ W., is in a coal region, with mines in the city. Water-works were built by the city, in 1884, taking the supply from wells and pumping.

Distribution is by 1½ miles of cast-iron pipe with, 16 fire hydrants and 28 taps. The daily consumption is 30,000 gallons. The Superintendent reports the cost of the works as $18,000 and the bonded debt as $38,000 at 6 per cent. interest. The yearly cost of maintenance as $1,000 and the yearly revenue $1,000. W. W. Ellis is the Superintendent. The population, in 1880, was 3,762.

WATER.

Gas and water pipes of cast glass are said to be suggested by some Anglo-German manufacturers. They are claimed to be as hard and tough as cast iron, and 30 per cent cheaper

IMPROVEMENTS ON THE MISSISSIPPI IN MINN.—The State Commissioners of Minnesoto reports that $418,367.38 has been expended upon the reservoir system of the Upper Mississippi. $1,225 000 is required to complete it.

SALEM, Mass., reports that, at the Wenham Lake pumping station, during the month of December last 70 tons of coal were burned; the pumps were run 262 hours and raised 63,412,650 gallons of water. The rainfall for the month was 5.43 in.

THE Peabody, Mass., Water Board reports the pumping of 17,268,930 gallons of water in December, an average of 550,062 per day. They consumed daily 1,304 lbs. of coal or an average of 397 gallons of water raised to each pound of coal.

ROBERT CURTIS has just been appointed to fill a vacancy in the Columbus, O., Board of Water Works Trustees. Mr. Curtis is master mechanic in the Chicago, St. Louis, Pittsburg, R. R. shops.

THE Wabash Hydraulic Company, with a capital of $12,000 was organized in Wabash, Ind., on Dec. 31. The purpose of the company is to improve the old Wabash and Erie Canal bed between Wabash and Lagro a distance of seven miles, and supply water power to the manufacturies of this city.

THE lower Thames valley main sewerage board on Dec. 20th, adopted a scheme of Sir Joseph Bazalgette for the disposal of the sewage of the combined district. The scheme proposes the total diversion of the sewage to land at Crossness. There will be pumping stations at Mortlake and Sutton. The cost is estimated at 563,711l., which will be repaid in sixty years by a rate of 3.81d. in the pound

THE Red Bank, N. J. Water Works are completed and were tested on Jan. 1st. The well furnishing the supply has a capacity of 250,000 gallons. A reservoir holding 800,000 gallons is situated 145 feet above tide and 120 feet above the main level of the town. The total cost of the work was $4 .000. About three miles of pipe are laid. The town is bonded for the works, paying 5 per cent. interest.

IT has been said for a century that at Yuma Cal., it seldom or never rained, and that it was the hottest place on the American continent. These fallacies have received a rude shock by the records of the United States Signal Service, which shows that the winter temperature in Yuma is much less than it is in Los Angeles while in regard to rain that locality has frequent showers, and not very small showers either.

THE proposition of the Ohio River Water Co., to supply Cincinnati is withdrawn. On December 30th, two reports were submitted to the City Councils; the majority report presented the opinion of the expert J. D. Cook, which included an ordinance to meet the requirements as existing under the propositions of the Ohio River Water Co., and also provided for more fully protecting the interests of the city of Cincinnati. The second report included the accepting of the Water Co.'s proposition under the modifications suggested by Mr. Cook, but it was not presented under a ruling of the chairman. The Water Co., then withdrew its propositions,

PREVENTION OF WASTE IN BOSTON.—Table showing the daily average consumption from the combined Cochituate and Mystic supplies, the consumption per inhabitant and the saving effected by the prevention of waste.

	Daily Average Consumption. Gallons.		Total Quantity Saved. Gallons.	Consumption per Head. Gallons.		Percentage Saved.
	1883.	1884.		1883.	1884.	
January	43,085,100	40,181,400	2,903,700	97.9	89.1	9.0
February	40,305,350	30,947,500	9,457,850	91.7	68.5	28.3
March	41,848,000	30,049,000	11,799,000	94.9	66.4	30.3
April	36,788,750	26,747,800	10,040,950	83.2	59.0	29.1
May	38,488,600	29,508,500	8,980,100	86.8	65.0	25.1
June	40,331,750	32,430,200	7,901,550	90.8	71.2	21.6
July	44,081,550	31,721,300	12,360,250	98.9	69.5	29.7
August	44,402,500	31,153,600	13,248,900	99.4	68.1	31.5
September	39,491,300	32,860,650	6,630,650	88.2	71.5	18.9
October	35,073,050	30,857,050	4,216 000	78.2	67.1	14.2
November	34,769,900	28,073,950	6,695,950	77.3	60.9	21.2

NOTE.—Inspection commenced July, 1883.

NEW HAVEN, Conn., has just discovered that its well water is tainted. Dr. Ed. H. Jenkins and Prof. Brewer, of Yale have found the water of six out of eighteen well examined is full of the germs of typhoid and other zymotic diseases.

A. C. MILLER, Robert Middleton and several other Utica capitalists, interested in manufacturing, have purchased a farm on Nine mile Creek, near Utica, with a view to building a reservoir to supply the city with water for domestic purposes. The stream has a daily flow of 11,000,000 gallons, and the water, on analysis, is found to be nearly pure. Surveys are being made to ascertain if the plan is feasible.

THE Water Board of Minneapolis on Dec. 24, awarded the contract for pipe required in 1885, to Dennis Long & Co., of Louisville, Ky., and that for special castings to Lockwood & Co., of Minneapolis, $.02.495 per pound. The detail of these bids will be found in the News of the week in this issue.

The Board also discussed the advisability of purchasing a machine for testing the pipe contracted for said machine to cost $3,000.

NEW PUMP WORKS FOR CINCINNATI.—At a late meeting of the Cincinnati Council the following resolution was adopted:—

Resolved: That the Superintendent of the Water-Works be, and he is hereby, directed to report to this board as follows: An estimate of the cost of establishing new pump works above the new gas works. What would be the cost of foundations. What would be the cost of grounds. What would be the cost of effluent pipes from that point to the reservoir, and how would this cost compare with that of a river-side sewer to carry the drainage of South Walnut Hills into Deer-creek for discharge.

PRESSURE REDUCING VALVE FOR WATER SUPPLY PIPES.—At a recent meeting of the Philosophical Society of Glasgow, a paper was read by Mr. William Key, of the Glasgow Corporation Gas Work, at Tradeston, on the regulation of the water supply of cities and towns, in the course of which the author described what seemed to be a very serviceable instrument in the shape of a pressure reducing valve of his own invention, and which has been brought into successful use in various towns in Scotland and England. It acts in a manner somewhat similar to one or two forms of gas governors.

AN examination of a series of water marks set in 1750 all around the Swedish coasts, from the mouth of the Torneato the Naze, in order to settle a dispute between the Swedish astronomer Celsius, and some Germans, as to whether the level of the Baltic has been rising or sinking shows that both parties are right. The gauges were renewed in 1851, and again last year, and have been inspected regularly at short intervals. It appears that the Swedish coast has been steadily rising, while that on the southern fringe of the Baltic has been as steadily falling.

Two important filters are described in the *Journal de Pharmacie et Chemie*. The Chamberland filter consists of a porous cylinder of ground porcelain burned to such a heat that it is capable of transmitting liquids but not solids. It is used in Pasteur's laboratory for separating microbia from their culture liquids. Pasteur has found that on filtering with it the most impure waters the germs of microbia cannot pass through it. In the Maigren filter the acting medium is a mixture of powdered hydrate of lime and of boneblack. This apparatus is said to be capable of removing not merely suspended but dissolved impurities.

OSWEGO WATER WORKS.

OSWEGO, N. Y., Dec. 31

EDITOR ENGINEERING NEWS.—Our attention has been called to a statement in respect to the Oswego Water Works in your valuable journal of Dec. 20th. In order to enable you to correct some errors in that statement we send you the following:

The Oswego Water Works has laid 32,000 feet of 3" mains, 76,000 feet of 4" mains, 16,500 feet of 6" mains, 28,000 feet of 8" mains and 7,500 feet of 10" mains, making about 30 miles in all instead of sixteen. There are 183 fire hydrants, 20 public fountains, 18 of which are called "water troughs" by your correspondent. The water is pumped by water power from the Oswego River into reservoirs, one on the east side on the river 190 feet above Lake Ontario, 8,000,000 gallons capacity one on the west side 150 feet above the lake of 7,500,000 gallons capacity. There are two sets of pumps, each with two double acting pistons 10" diameter 34" stroke. Each set is driven by two iron turbines 50 H. P. each 200 H. P. in all, and capable of driving pumps up to 140" pressure. The city has an arrangement for pumping into the mains for fire purposes, and as high a pressure as desired can be given in one minute. There are only about 800 water takers in a population of 25,000, and over 3,000,000 gallons per day is supplied.

Very Truly Yours,
N. M. ROWE, Supt.

NEWARK, N. J., complains of insufficient pressure on her fire hydrants. It should not be less than 45 lbs. but in some districts is as low as 20 lbs.

CINCINNATI WATER DEPT.—The Superintendent of Water Works of Cincinnati, submitted the following:

CINCINNATI, December 31, 1884.

To the Honorable Board of Public Works.—*Gentlemen:* I herewith hand you the following statistics relating to the operations of the City Water Department for the year ending December 31, 1884:

Number of gallons of water delivered to Eden reservoir	5,840,704,384
Number of gallons of water delivered to Third street reservoir	1,689,844,454
Number of gallons of water delivered to Mount Auburn tanks	541,391,680
Number of gallons of water delivered to Price's Hill tanks	26,793,949
Number of square yards of paving	28,759
Number of corrections of abuses and leaks	4,696
Number of consumers added	1,434
Number of main pipes repaired	551
Number of meters added	111
Number of elevators added	47
Miles of pipe laid	13

Yours truly, WM. H. BOEH.
Superintendent and Engineer.

NEWS OF THE WEEK.

Miscellaneous.

West St. Paul, Minn. is to have a new depot, to cost $2,000.

Fisher's Pipe Foundry, of Allentown, Pa. resumed operations on Dec. 31. Accumulated orders will keep the works busy all winter.

The American Water Gas Construction Co.—Of New York, was incorporated in Albany on December 30. Capital stock $1,000,000. Wm. C. Bucklin is Treasurer and Joseph H. Devon, Secretary.

New York Harbor.—Senator Miller, of New York, wants to have incorporated in the River and Harbor Bill, a provision for the prevention of injurious deposits in the harbor of New York.

Too Much Tower.—Rumors from Philadelphia, say that serious damage is being done to the granite and ornamental work of the New City Hall by the great weight of the tower causing a settlement in the masonry.

The Lidgerwood Man. Co., of New York, are building several special hoisting engines, large tubular boilers, buckets, sheave wheels, etc., intended for the contracting plant of Brown, Howard & Co. on Sections 2, 3, 4, and 5 of the New Croton Aqueduct.

Ship Building In England has fallen off 50 per cent., according to the annual reports of the Board of Trade of Scotland and North of England. The builders, however, say prospects for the future are brighter now than at any previous time for some months. The dullness of the carrying trade has sharpened competition to such an extent that only fast modern-built ships can be run. The market for this class of vessel is not over stocked and new ones must be built.

The Mississippi River Commission makes the following estimates for the fiscal year ending June 30, 1886: For surveys, $100,000; salaries and expenses of commission and assisting engineers, $100,000; river from Des Moines to Illinois River, $500,000; from Illinois River to Cairo, $1,000,000; between Cairo and head of passes, including Red River, at and below the Atchafalaya, $7,000,000; for harbors at Columbus, Ky., $80,000; Hickman, Ky., $270,000; Memphis, $75,000; Greenville, Miss., $186,000; Vicksburg, $20,000; Natchez, $700,000; New Orleans, $686,500.

Vanderbilt's Fortune Cut in Two.—Four years ago William H. Vanderbilt invested $50,000,000 in United States 4 per cent. bonds. Since that time he has converted $18,000,000 of these bonds into money. Financial men here say that within the past four years, Vanderbilt's fortune of $200,000,000 has been cut squarely in two. In 1880, New York Central was selling at 155, Lake Shore 135, Michigan Central 112, and Canada Southern 90. Quotations for the same stocks, on January 1, were 85, 61, 55 and 30, respectively. Vanderbilt's boys, including his son-in-law Twombly, have lost him $15,000,000 alone in the last two years.—*Minn. Tribune.*

Labor Notes.—According to the report of E. R. Hutchins, Superintendent of Labor in the State of Iowa, the average yearly earning of the head of a family, in that State, is $780, and the average family expenses only $400. This is $251 better showing than Illinois, $201 better than Ohio, and $453 better than Massachusetts. Five-sevenths of Iowa's workingmen own homes, while but one-third of Ohio's and two-sevenths of Illinois' workingmen enjoy a similar luxury. Carpenters in Iowa average $2.25 per day; masons, $3.65; blacksmiths, $2.80; painters, $2.50; plasterers, $2.67½; harnessmakers, $2, and laborers, $1.25.

A Commissioner of Rivers and Harbors.—Mr. Breckenridge introduced a bill into the House of Representatives, Washington, on Jan. 5th, to provide for the creation of a River and Harbor Department, which shall be under the charge of the Commissioner of Rivers and Harbors, to be appointed by the President, at a salary of $4,500. The jurisdiction and powers and duties of the Commissioner shall be the same as those now exercised by Chief Engineers in regard to rivers and harbors. Fifty thousand dollars is appropriated to be expended at the discretion of the Commissioner in making any special examination of works under his charge.

Board of Public Works, Cincinnati.—C. N. Danenhower, Chief Engineer, submitted a condensed statement of the workings of the Engineer's department for the year ending December 31, 1884. The report showed seventeen streets improved by macadamizing during the year at a total cost of $126,424, and four streets improved by bowldering at a total cost of $19,960. The number of miles of streets dedicated during the year is 7.88. Sewers of the length of 35,543 lineal feet have been completed at a cost to the city of $72,407, and a total cost of $170,598. The cost of bridge work completed during the year is $6,533.75. The number of feet of plank sidewalk laid by the city contractor is 124,608, at a cost of $3,015.39. The cost of sidewalk done by property owners through orders from the sidewalk department is $47,462.57. The number of lineal feet of gas pipes laid during the year is 53,000, making a total of 240 miles of gas-mains now in operation.

Cost of gas lighting, extinguishing, etc., $170,679.73; cost of gasoline lighting, extinguishing, etc., $32,676.17; cost of operating Engineer's department, $33,000.

Millions for Coast Defense.—WASHINGTON, Jan. 2.—The Sub-Committee of the House Committee on Appropriations, having in charge the Fortifications bill, intends to report to the full committee the same measure that was rejected by the House at the last session of Congress. It provides for an appropriation of about $7,000,000. Secretary Lincoln recommends the appropriation of $880,000 for four turrets, exclusive of armor, for the defence of Boston Harbor, $1,120,000 for five turrets, exclusive of armor, for the defence of New York Harbor; $50,000 for a sea wall around Governor's Island, New York Harbor; $75,000 for jetties for protecting the site of Sandy Hook; $132,000 for rifles and mortars for the defence of Philadelphia Harbor; and $132,000 for rifles and mortars for the defence of Baltimore Harbor; $660,000 for three turrets, exclusive of armor, for the defence of Hampton Roads; $900,000 for three turrets, exclusive of armor for the defence of San Francisco Harbor; $500,000 for the modification of existing forts and batteries, and for continuing the construction of incomplete batteries to adapt them to modern ordnance; $560,000 for torpedoes for harbor defence, and $2,100,000 for the armament of fortifications.

Contracting.

Iron Beams.—The following is a synopsis of the bids for iron beams for the court house, etc, at Hannibal Mo., received in response to circular letter:

H. L. Fox & Co., St. Louis, Mo., $409.43.

E. E. Souther & Bro., St. Louis, Mo., $421.23.

Carnegie Bros. & Co., Pittsburg, Pa., $464.28.

Phœnix Iron Company, Philadelphia, Pa., $464.73.

New Jersey Steel and Iron Company, New York City, $470.07.

Ætna Iron Works, Quincy, Ill., $476.18.

Bids for Cast-Iron Water Pipe.—Opened at Minneapolis, November 18, 1884, but not yet let (December 23)

NAME OF FIRM.	507½ Tons. 6 inch.	525 Tons. 8 inch.	42 Tons. 10 inch.	279 Tons. 12 inch.	101¾ Tons. 16 inch.	456¾ Tons. 24 inch.	Total amount of bid.	Average per ton.	Castings. Sand.	Castings. Loam.
Dennis Long & Co	$28.24	$27.97	$27.49	$27.49	$26.94	$26.94	$52,853.38	$27.65	2 5-8c	4¼c.
Shickle, Harrison & Co	27.99	27.99	27.99	27.99	27.99	27.99	53,488.87	27 99	2 6-10c.	4 3-10c.
Camden Iron Works	30.25	30.25	30.25	30.25	30.25	30.25	57,807.74	30.25	$56 per Ton.	
Lake Shore Foundry	29.50	29.20	28.95	28.70	28.50	27.50	54,956.94	28.75	.....	.....
Cincinnati & Newport Pipe Co	29.10	29.10	29.10	29.10	29.10	29.10	55,602.82	29.10	3c.	5 c.
A. H. McNeal	32.98	32.98	32.98	32.98	32.98	32.98	63,024.77	32.98	3¼c.	.....
Warren Foundry	29.70	29.70	28.70	28.70	28.70	28.10	55,504.44	29.09	2 7-10c.	.....
Gloucester Iron Works	31.79	31.79	31.79	31.79	31.79	31.19	60,476.92	31.64	.....	.....

SPECIALS.

Barney & Kilby, Sandusky, Ohio	$58.00
North Star Iron Works Co	2½c.
Pray Manufacturing Co	2½c.
Lockwood, Upton & Co	2.49½c.

L. M. Morris, Pittsburg, Pa., $498.77.

The bid of H. L. Fox has been accepted.

Building Pile Wharves.—The following bids for building pile wharves in the Harbor of Refuge at Wood's Holl, Mass., were opened at the engineer's office at Newport, R. I., on January 2. Proposals are for the various materials in place; the timber and plank per thousand feet B. M., the iron per pound, in the following order: Piles (each), hard pine timber, hard pine plank, spruce timber, spruce plank, wrought-iron, wrought-iron spikes, and cast-iron cleats and sheaves. The gross amount of each proposal is also given.

Wm. H. Molthrop, Gales Ferry, Conn.—$7.50, $32, $35, $24, $23, 6c., 5c., $10,907.50.

James C. Terry, Fall River, Mass.—$11, $38, $38, $28, $28, 6c., 5c., $13,672.

John R. Smith, Springfield, Mass.—$13, $30, $38.50, $23, $23, 6 1-2c., 6 1-2c., 5c., $11,057.75.

George H. Cavanagh, Boston, Mass.—$12, $10, $40, $30, $30, 7c., 6c., 6c., $14,857.

Charles E. Davis, Wood's Holl, Mass.—$13.75, $47.45, $46.95, $35.19, $31.50, 9c., 5c., 7c., $17,198.13.

Alex. McInnis, Boston, Mass.—$14.97, $19, $74, $40, $35, 12c., 6c., 6c., $19,961.06.

P. Sanford Ross, Jersey City, N. J.—$22, $49, $49, $34, $34, 6c., 5c., 6c., $21,100.

Cast-Iron Water Pipe.—The following is an abstract of the bids received by Mr. John Carmichael, town engineer, Lexington, Rockbridge County, Va., for furnishing 140 tons of cast iron water pipe:

Tredegar Iron Works, Richmond, Va., 2,000 pounds to the ton, $30 per ton.

Gloucester Iron Works, Gloucester, Pa., 2,240 pounds to the ton, $36.69 per ton.

T. B. Cranshaw, Richmond, Va., for R. D. Wood & Co., 2,000 pounds to the ton, $29.95, 25 cents extra for stacking pipe; 2,240 to the ton at $33.54 per ton.

Chattanooga Iron and Pipe Works, Chattanooga, Tenn., 2,000 pounds to the ton, at $31.50 per ton.

Mullin Iron Works, Lexington, Va., 2,240 pounds to the ton, at $38,40 per ton.

Pancoast & Rogers, Lexington, Va., 2,240 pounds to the ton, at $36.50 per ton.

W. H. Ford, Lexington, Va., 2,240 pounds to the ton at $41.50 per ton.

Dennis Long & Co., Louisville, Ky., 2,000 pounds to the ton, at $34 per ton.

Buchenbrook Foundry, Jolliffe & Estelle, Lexington Va., 2,240 pounds to the ton, at $36.50 per ton.

The town council awarded the contract to the Buchenbrook Foundry. The pipe is to be delivered by them along the line; special castings to be made for 2 3-16 cents per pound; 140 tons of 6-inch pipe 30½ pounds to the foot, 12 feet long, will probably be used. The other bids were for delivery in Lexington and stacking on depot yard.

River and Harbor Improvements, South Atlantic Coast, Contract prices January, 1885.

CHARLESTON HARBOR.—Alfred Ames Howlett, Contractor, Log Raft, 12" thick, 40' to 130' wide, covered with 5" loose brush, 67 cents per square yard, in place, Rip Rap stone, 15 to 400 pound pieces, 12" thick on mats—$3.41 per cubic yard. $20,000 worth of work per month. Appropriation $250,000.

SAVANNAH HARBOR.—John F. Gaynor, Contractor Log Raft, 12" thick, 15' to 80' wide, covered with 6" brush in bundles—47 cents per square yard. Rip Rap stone, 15 to 200 pound pieces, 7" to 18" thick on mats—$3.05 per cubic yard. $16,000 worth of work per month. Appropriation $200,000.

BRUNSWICK HARBOR—John S. Howell, Contractor. Log Raft, 9" thick, 20' to 50' wide, covered with 5" brush—73½ cents per square yard. Rip Rap stone, 15 to 400 pound pieces, 12" to 18" thick on mats—$3.09 per cubic yard. $4,000 worth of work per month. Appropriation $10,000

CUMBERLAND SOUND.—Lara and Ross, Contractors. Log Raft, 12" thick, 20' to 100' wide, covered with 5' brush 59 cents per square yard. Rip Rap stone, 15 to 400 pound pieces. 9" to 24" on mats—$3.09 per cubic yard.

ALTAMAHA RIVER.—Edward H. Gaynor, Contractor, Facine mats, 12" to 15" thick, 15' wide. $1.17 per cubic yard: Rip Rap stone, 6" cubes or smaller, $4.47 per cubic yard; Rip Rap gravel, .49 per cubic yard, $2,000 worth of work per month. Appropriation $15,000.

SAVANNAH RIVER.—Edward H. Gaynor, Contractor, Facine mats, as above $0.93 per cubic yard; Stone, $2.31 per cubic yard; Gravel, .47 per cubic yard. $2,000 worth of work per month. Appropriation $15,000.

DREDGING.—*Savannah Harbor.* P. Sandford Ross, Contractor, mainly sand, some mud, tow 1 mile, 17¾c. per cubic yard, measured in scows.

Romerby Marsh. P. Sanford Ross, Contractor, Sand, marsh mud and clay, tow 1 mile, 21⅛ cents per cubic yard, measured in scows.

Electric Light in Chicago.—In answer to the advertisement of the Controller for proposals to light the new City Hall, the streets, Parks, and tunnels the Edison Electric Light Company sent in a proposal to equip the new City Hall, Washington and La Salle street tunnels with an Edison electric light plant. The necessary paraphernalia according to their estimate consists of one 14½x 13 Armington & Simms automatic cut-off high-speed engine, two Edison dynamos, each with capacity to generate current sufficient to supply 400 sixteen-candle Edison lamps, the latter to be connected with the 14½x13 engine by belting; two other Edison dynamos, each having capacity to generate sufficient to supply 300 sixteen-candle Edison lamps, the latter to be connected with the 13x13 engine; and 1,200 sixteen-candle Edison lamps, each lamp to be so constructed that it may be turned on or off separately. The equipment machinery for the tunnels is placed at 150 sixteen-candle Edison lamps for the La Salle street tunnel and 125 sixteen-candle-power lights, to be connected by underground conductors with the machinery located in the City Hall.

The price to be paid for this plant is put at $41,375, to be paid within thirty days after the work shall have been completed, lamps for renewals in connection with the plant to be furnished at 85 cents each.

Philadelphia Intercepting Sewers.—Bids were opened on December 24th, for building a continuation of the intercepting sewers along the Schuylkill River from Manyunk to the Fairmount Dam, Philadelphia. The bids opened were for the construction of three sections, respectively numbered six, seven and eight. The first named section is 804 feet in length, running through the tunnel on the river drive; the second, with a length of 3030 feet, reaches from near the Strawberry landing to Nicetown Lane, at a point between the Middle and South Laurel Hill Cemeteries, and the third section is 2,650 feet in length, extending from above the Laurel Hill landing to the Reading Railroad near the Falls Village. Most of the work to be done is through a hard rock, and will require much trouble to do the work properly

The bids took a wide range in price, the lowest figures being those of Bernard Malone & Co., of Lancaster, as follows: For section six $9 per lineal foot; section seven, $9, and section eight, $8.50, with sixty cents a foot for terra cotta pipes and fifty cents a foot for filling up the river drive. Terrence Reilly is the highest bidder, offering to do the work on section six for $49, on section seven for $12.73, and on section eight, $16.50, with pipe at $5 and earth filling at seventy-five cents. The bids were referred to the chief of the department for his consideration, a report to be made in the Survey Committee.

The sum of $125,000 for continuing the intercepting sewer is included in the appropriation for 1885 to the Survey Department, and the figures offered by Malone will bring the cost of the three sections to $87,811, to which can be added about $10,000 as the cost of pipe and earth filling. Mr. Smedley was inclined to regard the proposal of Bernard Malone with grave doubts. The next lowest bidder is W. H. H. Achuff, at $19.89 for section six, $16.95 for section seven, and $9.97 for section eight.

Phila. Water Pipe.—Bids were opened at the Water Department for supplies for 1885, and the bids for cast-iron water pipes were: A. H. McNeal, 1.43c. per pound for 4-inch; 1.41c. for 6-inch; 1.395c. for 8-inch; 1.34c. for 10 inch; 1.318c. for 12-inch; 1.294c. for 16-inch; 1.17c. for 20-inch; 1.17c. for 30-inch; 1.14c. for 36-inch; and 1.14c. per pound for 48-inch pipe. The Mellert Foundry &

Machine Co. bid 1.50c. per pound for 4-inch: 1.35c. for 6-inch; 1.35c. for 8-inch; 1.32c. for 10-inch; 1.30c. for 12, 16, 20, and 30 inch each; 1.35c. for the 36 and 48 inch pipe per pound. The Camden Iron-Works, Walter Wood, President, bid 1.34c. for the 4-inch per pound; 1.28c. for the 6 and 8 inch; 1.249c. for the 10 and 12 inch; 1.218c. for the 16 and 26 inch; 1.19c. for the 30, 36, and 48 inch pipe per pound, respectively, these prices being subject to a 20 per cent. variation. The Gloucester Iron Works bid 1.28c. per pound for the 4, 6, 8, 10, and 12 inch pipe; 1.236c. per pound for the 16 and 20 inch pipe; 1.203c. per pound for the 30, 36, and 48 inch pipe. The contract for 20, 30, 36 and 48 inch pipe was awarded to A. H. McNeal; for the 10, 12, and 16 inch to the Camden Iron-Works, and the Gloucester Iron-Works was awarded the 4, 6, and 8 inch pipes. For special pipe-castings the bidders were 2.46c. per pound for castings of the pipe from 6 to 16 inches and 2.58 cents per pound for the castings required for the pipes from 20 to 48 inches, by the Camden Iron-Works. The Mellert Foundry and Machine Co. bid 2.20c. for the 6 to 16 and 2.30c. for the 20 to 48 inch. A. H. McNeal bid 2.45c. for the 6 to 16 and 2.49c. for the large The Gloucester Iron-Works bid 2¼ per pound for all. The bids for breeches pipe for the 20 to 48 inch pipe were; Camden Iron Works, 5 cents per pound; Mellert Foundry and Machine Co., 5¼c.; A. H. McNeal, 4.47c.; and the Gloucester Iron Works at 5 cents. The Mellert Foundry and Machine Co. was awarded the contract for the special castings, and A. H. McNeal for the breeches pipe. The bidders for the iron castings for the shop and special machine castings, made in Philadelphia, the estimated amount required being 530,000 pounds, were: Adams & Stone, 1⅞c. per pound; John I. Dawson & Son, 1¾c. per pound; W. A. Ellis & Co. 1¾c. per pound; Whitaker & Co., 1.85c. per pound; and David Cresswell, who received the contract at 1.69c. per pound.

Railroads, Bridges and Canals.

The Keystone Bridge Works employees have accepted the 10 per cent. reduction in wages, and work was resumed on Jan. 5.

A New Canada Canal.—OTTAWA, ONT., December 22.—An attempt is being made to get up a company to construct a canal across the small peninsula between Lake St. Clair and Lake Erie, in Western Ontario.

An Electric Railway.—NEW YORK, January 1.—Articles of incorporation of an electric railroad, to run from Far Rockaway to the Long Island Railroad, have been filed. Capital $200,000.

The Burning of the Bristol Tunnel.—The Bristol Tunnel on the Shawnee Division of the B. & O. R. R. three miles from Lexington, O. was burned by a mob on Jan. 1. The loss to the R. R. Co., will be about $150,000. The wrecked tunnel will have to be converted into an open cut.

Cal. Southern Extension.—SAN FRANCISCO, DEC. 24.—A special to the *Chronicle* from San Bernardino says: "The California Southern Railroad has ordered the extension of its road to connect with the Atlantic and Pacific Road at Daggett. Five hundred men will be at once set to work."

Jamaica Railroads.—There are 61½ miles of railroad of 4 ft. 8½ in. gauge in the Island of Jamaica. This system cost $3,500,000, and the operating expenses are 46.05 per cent. The passenger fares are first-class, 5 cents; second-class, 4 cents; third-class, 2 cents, per mile.

New Kansas R. R's.—Two new railroads were chartered at Topeka on Dec. 25. The Kansas City & Southwestern R. R., capital $54,000; is to run from the Kansas & Arizona branch of the Miss. Pacific, near Paola, to Kansas City. And the St. Louis, Kansas City and Colorado R. R., capital stock $20,000,000, standard gauge, length 850 miles.

New Minnesota R. R's.—The Wis. Min. & Pacific R. R., completed, on Dec. 1, their line from Red Wing to Eagle Lake. The St. Paul & Northern Pacific R. R. Co., has filed, Dec. 30, amended articles of incorporation. The amendment provides for one or more lines from Brainerd to Sauk Rapids, thence by the Minneapolis & St. Paul to Mankato, with one or more branches to the eastern boundary of Minn., and to a point on the Northern Pacific between Brainerd and Wadena.

The Boston & Maine, Ry.—Eastern Division has just completed a new iron draw in the bridge over Bass River, between Salem and Beverly. It was built by the Passaic Rolling Mill Co., and erected by the Ry. Co. It is a double track pivot span of four plate girders, 105 ft. long and 5 deep giving two clear openings of 40 ft. width. The pier is of granite 18x20 ft. resting on 100 piles, driven through 18 ft. of mud to the bedrock. The old draw is being removed, and the remainder of the bridge, a pile structure of about 800 ft. is being put in repair.

The Ry. Co. has in preparation plans for a new iron bridge over the Merrimac at Newburyport, to take the place of the present bridge of wood. The present piers will probably be used, as they were planned for a double track bridge originally.

New North Carolina R. R.—RALEIGH, N. C., Dec 23.—Mitchell County had just voted to subscribe $100,000 in bonds to aid in the construction of a railroad from Gaffney, on the Atlanta Air Line Railroad, through Rutherford, McDowell and Mitchell Counties, to Johnston Station, in Tennesee, on the Norfolk and Western Railroad.

Texas Roads.—AUSTIN, TEX., Dec. 22.—The forthcoming annual report of State Railroad Engineer Britton shows that the total railway mileage of the state of Texas to the first of December was 6,723 miles, being an increase for the year of 268 miles. Colonel Britton is authority for the statement that there is no truth in the report that the Missouri Pacific system in Texas intends to cut down the wages of its employes.

A New Telegraph Syndicate.—CHICAGO, Dec. 24.—A new and powerful telegraph syndicate, it is said, will enter during the early part of the new year actively into opposition to the Western Union. John W. Mackay, of the Postal Company; Robert Garrett, of the Baltimore and Ohio; James Gordon Bennett, and the bondholders of the Bankers and Merchants' Company are said to be the moving spirits in the enterprise.

A New Missouri Road.—JEFFERSON CITY, MO., December 22.—Articles of association were filed this afternoon, in the office of the Secretary of State, by the Holden, Clinton and Southwestern Railway Company. The capital stock of the corporation is $1,100,000. The proposed road will be 110 miles long, and will run from Holden, in Johnson County, to Springfield, in Greene County.

Memphis, Selma & B. R. R.—A circular from the receiver states that construction on the Memphis, Selma and Brunswick Railroad Company will be resumed immediately between Holly Springs, Miss., and Memphis, Tenn., and the track already laid placed in repair without unnecessary delay. R. J. Evans has been appointed Chief Engineer, W. P. Dunavant, Superintendent of Construction, and O. H. P. Piper, Purchasing Agent.

The Virginia Beach R. R.—NORFOLK, VA., Dec. 19.—In the Corporation Court to-day Judge Brooke, at a request of the creditors, appointed C. G. Elliott and R. B. Cooke Receivers for the Virginia Beach Railroad Company. The company has a railroad from Norfolk to its hotel on the ocean and recently became insolvent. Judge James H. Hopkins, of Pennsylvania, is President of the road, and the bonds are held principally by C. W. Mackay, a brother of the "bonanza king."

Alabama vs a Railroad.—CHATTANOOGA, TENN., Dec. 19.—The State of Alabama has entered a suit against the Directors of the Alabama and Chattanooga Railroad Company, a corporation which became bankrupt in 1872, for $3,000,000 damages alleged to have been sustained by the State through their mismanagement. It has been decided that the United States Supreme Court has original jurisdiction in the case.

Denver, N. O. & Mis. Pacific R. R.—DENVER, COL., Dec. 19.—Articles were filed to-day with the Secretary of State incorporating the Denver, New Orleans and Missouri Pacific Railroad Company, to run from a connection with an extension of the Missouri Pacific Railroad 20 miles north of the southwest corner of Kansas to a connection with the Denver and New Orleans Railroad, east of Trinidad. Jay Gould, Russell Sage, John Evans, C. W. Fisher, and C. B. Kountze are named as Directors for the first year.

Economy on the Erie.—President King, of the Erie, has already cut down the expenses of the Erie per annum $600,000, and is by no means through. On the New York, Pennsylvania and Ohio he has directed that salaries of all officers and agents which now range above $2,000 shall be reduced 25 per cent. He has also dispensed with pay-cars and paymasters, leaving payments to be made by Division Superintendents. This system has long been in vogue on the Pennsylvania and has worked to perfect satisfaction. A paymaster costs from about $2,000 a year upward, and his clerk about $600.

Philadelphia's Elevated Road.—PHILADELPHIA, PENN., Dec. 26.—The City Solicitor gave an opinion to-day that the charter of the Philadelphia and Northern Railroad Company, which is to construct a railroad in this city, is in regular form, but the company will be liable for all real and consequential damages arising from the construction of the road. An ordinance now before a committee of the City Councils grants permission for the constructing of an elevated road of iron or steel, with regular double tracks, to be operated within the limits of the city, from the boundary lines between Montgomery and Philadelphia Counties to a point near Somerset and Front streets; along Front to Snyder avenue, to Winter street; along Frankford avenue to a point at or near Harrison street; thence to Tacony. There is a proviso to the effect that in consideration of the permission being granted the company is to appropriate 5 per cent. of the gross receipts for the use of the city.

The ordinance also provides that before work is commenced the company shall deposit with the City Treasurer bonds of the company of par value to the amount of $1,000,000.

Extension, Union Pacific.—It is reported that the Union Pacific will build an extension from Crete, Neb. to Belleville, Kan., via Chester.

The Niagara Cantilever bridge has just been inspected in every part and found in excellent order throughout. The Grand Trunk Suspension Bridge is also in first class order.

The Tampico Branch of the Mex. Central resumed work at the close of the rainy season. At the close of November track was being laid at the rate of one *kilometer* per day.

Maine Railroads.—The last annual report of the R. R. Com's of Maine states that the total mileage now operated in that State is 1,158⅝ including two horse railways of 14⅛ miles. The total number of roads is 43.

Heavier Engines for Third Avenue N. Y.—Twenty-five new engines will soon be ready for use on the Third avenue elevated road. They are two tons heavier than the engines now used. The trip from Harlem to South Ferry will be made in thirty-eight minutes instead of forty-three minutes.

Steel Ties.—The *Ironmonger* says that the Barron Hematite Steel Co., has succeeded in manufacturing steel railway sleepers at a cost of only a few shillings in excess of the price of wooden ties. The Northeastern Railway Co. has sent in an order for some of them on trial.

The Philadelphia and Erie Railroad Company reports its gross earnings for November as $326,288; expenses, $179,597, and net earnings, $146,691, being a decrease of $3,056.27 as compared with the corresponding month of last year. The net earnings of the company for the 11 months of this year were $1,376,119, being a decrease as compared with the corresponding period of last year, of $73,995.83.

Operating Expenses of New England Roads.—The percentages of operating expenses to gross receipts on New England roads the past year has been as follows: Eastern, 66 per cent. of the gross earnings; Boston & Maine, 64; Fitchburg, 71; Boston & Albany, 69; New York & New England, 88; Boston & Providence, 74; Old Colony, 67. The net earnings per mile of road appear thus: Eastern, $4,031; Boston & Maine, $5,076; Fitchburg $4,168; Boston & Albany, $6,001; New York & New England, $1,03; Boston & Providence, $6,569; Old Colony $,2880. This is not as favorable an exhibit as a majority of the Western roads will make, so far as operating expenses are concerned; yet, the earnings per mile of the New England roads are in excess of those of a majority of the Western roads—unquestionably, Western roads are operated most economically.

New Jersey Lines.—Sites & Harrison, Civil Engineers, and the experts employed by the N. J. State Board of Assessors to appraise the taxable value of railroad property in that State, have prepared a table for comparison of the values fixed by the board upon the possessions of the three great lines in the State—the Central, United New Jersey Railroad and Canal Company, now leased by the Pennsylvania, and the Morris and Essex, now leased by the Delaware, Lackawanna and Western. The table is as follows:

	United Railroads.	*Central and*	*Morris and Essex.*
Terminal lands per acre	$53,149	$35,505	$49,822
Main stem per acre	4,906	5,497	3,707
Main track per mile	7,809	7,534	7,166
Sidings and yard tracks per mile	6,050	5,724	4,328
Graduations per mile	20,903	24,062	19,598

R. R. Earnings.—Below is given the earnings of twenty-five roads for the first week of December. Of the number, twenty show increased and five decreased earnings, as compared with the corresponding week of last year:

	1883.	1884	Increase.
Canadian Pacific	$ 94,000	$130,000	$36,000
Chesapeake, Ohio and S. W.	28,592	36,026	7,434
Chicago and E. Illinois	33,031	40,200	7,169
Chicago, Mil. and St. Paul	514,843	536,000	21,152
Chicago and Northwestern	485,900	489,700	3,800
Chi., St. P., Minn. and Oma.	109,300	121,000	11,700
Long Island	45,760	47,955	2,195
Louisville and Nashville	290,705	309,555	18,850
Mil., L. S. and Western	20,805	21,650	755
Ohio Central	18,862	23,563	4,701
Rochester and Pittsburg	20,116	23,532	3,415
St. Louis and San Francisco	96,600	98,705	2,100
St. Paul and Duluth	19,647	30,188	10,541
Wabash	370,816	371,000	184
Illinois Central	316,546	327,200	10,654
C., L., St. L. and C	40,110	46,340	6,230
Eliz., Lex. and Big Sandy	12,475	14,658	2,183
Kentucky Central	15,113	15,943	830
Boston, H. T. and Western	7,045	8,444	1,398
Bur., C. R. and Northern	69,956	73,775	3,819
Peoria, Dec. and Evansville	15,035	13,409	*1,634
Chesapeake and Ohio	70,985	70,564	*421
Det., Lans. and Northern	25,031	19,053	*5,977
Denver and Rio Grande	119,999	109,196	*10,803
Chicago and Alton	192,136	179,839	*13,299

*Decrease.

The Grand Trunk traffic receipts for 1884 are about $17,000,000, a decrease, as compared with those of 1883, of over $2,000,000.

Philadelphia Branch B. & O. R. R.—The last rail of that portion of the line lying within the State of Delaware was laid Dec. 29, and the first train of cars passed over this completed portion between the Maryland and Pennsylvania State lines, a distance of 18 miles, on Dec. 30. The bridge over the Brandywine at Wilmington is as yet a temporary frame structure, to be replaced by a substantial iron structure within six months. It was necessary to have the road through Delaware in running order by January 1, to avoid a forfeiture of charter.

Report of Illinois Railroad Commissioners.—Chicago, December 31. The Railroad and Warehouse Commissioners of the State have issued their fourteenth annual report. They received reports from all the fifty-four railroads operating in the State. During the year 117.19 miles of new road were constructed, not including double-track and sidings. The aggregate of main line and branches is 31,059.19 miles; double track 931.26 miles, and sidings, 4,685.39. The increase in miles of main line and branches over 1883 is 1,689.35; double track, 1,943; sidings, 489.34. The total length of all tracks in Illinois is 9,141.91 miles of main line and branches. Illinois this year as before, leads all other States in railroad mileage. The capital stock of 62 roads, including leased lines, reported this year was $666,610,725, an increase over last year of $18,183,505; average stock per mile, $26,845. The total gross earnings of 50 corporations reporting for the year ending June 30, 1884, shows a loss of $3,918,866.79 as compared with 1883. The gross earnings from Illinois business amount to $56,457,136.39. The total of operating expenses and taxes paid in Illinois is $36,473,227.85; aggregate gross profit on Illinois business, $19,983,910.54. The returns of the various corporations reporting show a balance applicable to dividends after deducting disbursements for operating expenses, taxes, interest, rentals, and extraordinary expenses of $31,348,849.34, against $36,374,474.67 for 1883, and $28,912,847.14 for 1882. The total number of passengers carried by the roads reporting was 53,782,543, of which 18,788,371 were through passengers and 34,954,172 were local passengers. Of the local passengers 10,603,384 were carried in Illinois. The total number of persons killed by railroad accidents within the State was 376, and the number injured 975. Last year 385 were killed and 810 injured. The physical condition of the roads inspected is reported good. Steel rail is being generally used, and there is a marked improvement in the bridges, trestles, depots, stations and tracks.

The warehouses are reported in good condition. The storage capacity of the warehouses of class "A" in Chicago at the present time is 26,200,000. The total amount of bushels of grain in inspected for 1884 was 128,648,362 bushels; out inspected, 58,830,778 bushels.

Review of the Year's Work.—The *Railway Age* has the following: "The year 1884, now closing, has not been an auspicious one for the railways. Earnings have been reduced, while managers and employes are apprehensive for the future. It is shown that foreclosure sales of roads, for some time bankrupt, have been going on, but not to an alarming extent. Fifteen roads, with a mileage of only 650 miles, have thus been sold. In the previous year 18 roads, with a mileage of 1,350 miles, were sold, and this was less than for several years preceding. But the number of companies which, during the present year, have gone into the hands of Receivers indicates that a new era of foreclosures have begun, although it is not likely to be of long duration. In 1884 Receivers were appointed for 43 different companies, several of them of much importance, including the New York, West Shore and Buffalo, Wabash, St. Louis and Pacific, Philadelphia and Reading, Denver Rio Grande, Alleghany Valley, Ohio Central, Texas and St. Louis, Denver and Rio Grande Western, Portland and Ogdensburg, Memphis and Little Rock, Wheeling and Lake Erie, and some others of less note. Not a few other companies are struggling with difficulty to keep their heads above water, and unless the times and the public temper improve, there is likely to be a considerable addition to the list of Receiverships during the coming year. The construction record of 1884 has not been a remarkable one, although the total is even greater than could perhaps have been expected. About 4,000 miles of new main track have been laid on 166 different lines. This shows an average of only about 24 miles to each road, which indicates that most of the construction has been on extensions or branches. The very large number of railway enterprises commenced or projected during the year indicates that building will still continue, in spite of business depression, and that when good times return it will assume extraordinary activity. A glance at the map is only necessary to show that a great amount of railway building must be done before this country will be fully supplied, and the number of companies that have already been organized shows that there is plenty of faith in the future. Add to this the fact that every year's increase of railway mileage means the necessity of an increased supply of railway equipment and material, and those interested in the manufacture and sale of railway goods have no reason to feel discouraged. Their business must inevitably increase, and no man can set bounds to its possibilities."

Market Report of Engineering Materials.

New York, January 10, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.			
STRUCTURAL IRON.			
Angles	2.3c.	@	2.6c.
Bridge plate			
Tee	2.8c.	@	3c.
Beams and channels	3.5c.		
Tank	2.3c.	@	2.3c.
Shell	2¾c.		
Steel plates, Tank	3c.	@	3½c.
WROUGHT-IRON PIPE.			
Butt welded, black ... Discount	45		
" " galvanized ... "	30	@ 35	
Lap welded black ... "	60	@ 65	
" Galvanized ... "	40	@ 45	
Boiler tubes			
RAILS.			
Steel (large lots at mill)	$28	@ 30	
Old rails	16.50	@ 17	
Old steel rails	16	@ 17	
R. R. spikes			2c.
R. R. splice-plates	1.65c.	@	1.75c.
R. R. Track Bolts	2¼c	@	2½c.
Barb-wire fencing, galvanized			5c.
" " painted			4c.
Corrugated iron			
BRICK.			
(Cargoes afloat)			
Haverstraw 1st ... per M.	$6.00	@	6.12½
" 2nd ... "	5.50	@	5.75
Fishkill	4.75	@	5.50
Up-River	5.00	@	5.50
Jerseys	4.50	@	5.50
Long Island	5.50	@	5.75
" pale	3.00	@	3.25
FRONTS.			
Croton red	14.00	@	15.00
" dark	14.00	@	15.00
" brown	13.00	@	14.00
Philadelphia pressed	22.50	@	23.00
Trenton "	22.00	@	23.00
Baltimore "	37.00	@	41.00
Buff "	33.00	@	35.00
Enameled English	65.00	@	130.00
" American	85.00	@	120.00
Fire brick	25.00	@	35.00
CEMENT.			
PORTLAND.			
Robins & Co., Extra English 425 lbs	2.75	@	2.90
K. B. & S. English 400 lbs	2.65	@	2.80
Burham " "	2.50	@	2.60
Rochester Castle " "	2.50	@	2.60
J. B. White & Bro. " "	2.50	@	2.60
Other brands, " "	2.40	@	2.50
Keene's fine " "	9.50	@	9.75
" course " "	5.25	@	5.50
Roman	2.75	@	3.50
Dyckerhoff, German 400 lbs	2.60	@	2.65
Star, " "	2.60	@	2.65
Alsen, " "	2.55	@	2.60
Hanover " "	2.40	@	2.50
Other brands, " "	2.35	@	2.40
Saylor's American	2.15	@	2.50
Rosendale cements	0.90	@	1.00
LIME.			
Rockland common per bbl	1.00		
" finishing	1.20		
Glenfalls, common	.85		
" pointing	1.05	@	1.10
Kingston, ground	0.95		
STONE.			
Cargo rates at New York.			
Amherst freestone, No. 1 per cub. ft	0.90	@	1.00
" " No. 2 "	0.75	@	0.80
" " light drab "	0.80	@	0.95
Berlin " in rough "	0.75	@	1.00
Berea " "	0.75	@	1.00
Brownstone, Portland, Ct. "	1.00		
" Belleville, N. J. "	0.75	@	1.25
Granite, rough	0.60	@	1.25
Common building stone per load	2.00	@	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@	3.00
SLATE.			
Purple roofing per square	6.00	@	7.00
Green "	6.00	@	7.00
Red "	15.00		
Black Penna. (at New York) "	4.50	@	5.00
LUMBER.			
PINE, Common box per M.	18.00	@	20.00
Good "	55.00	@	60.00
Tally plank, 1¼ in each	.44	@	.50
Tally boards, dressed "	.28	@	.30
SPRUCE, Boards dressed "	.25	@	.28
Plank, 1¼ in "	.28	@	.30
" 2 in. "	.38	@	.40
" 2 in. dressed "	.43	@	.45
Timber per M.	20.00	@	22.00
HEMLOCK, Boards each	.18	@	.20
Joist, 2½ × 4 to 4 × 6 in	.17	@	.44
OAK per M.	55.00	@	65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00	@	40.00
YELLOW PINE, Girders "	26.00	@	35.00
Dressed flooring "	30.00	@	40.00
SHINGLES, Extra shaved pine, 18 in. "			
" " sawed " 18 in. "	4.50	@	5.00
LATH, Cargo rate "	2.50	@	2.60
PAINT.			
Lead, white, American dry per lb.	.04¾	@	.05
" in oil pure "	.05½	@	.05¾
English, B. B. in oil "	.08½	@	.08¾
Red, American "	.05½	@	.05¾
Litharge "	.05	@	.05¼
Venetian red, American "	.01	@	.01¼
Indian red "	.05	@	.10
Vermillion, American lead "	.11	@	.11½
Paris green "	.15	@	.19
Umber, Amer. raw and powdered "	.01¼	@	.01½
Drop black, Amer.	.08	@	.12
" " "	.09	@	.11½
Chrome green	.05	@	.15
Oxide zinc, American	.03¾	@	.04
" " French	.06¼	@	.06½